CHAPTER

21

AIR CONDITIONING

CHAPTER 21

AIR CONDITIONING

HIGHLIGHTS

'O:		ALL HOLDERS OF DC-8 SEVENTY SERIES MAINTENANCE MANUAL
CONCERNING:		REVISION 19, CHAPTER 21, DATED: APR 1/88
21-CONT		REVISED TO PROV DE NEW GENERIC TABLE OF CONTENTS.
21-IDENT		REVISED TO PROVIDE NEW GENERIC AIRPLANE IDENTIFICATION LIST.
21-61-0	D&O	REVISED TO CORRECT SECTION HEADING.

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DC8-71CF	45897	313
DC8-71CF	45898	320
DC8-71CF	45900	316
DC8-71CF	45902	294
DC8-71	45907	288
DC8-71	45913	325
DC8-71	45914	292
DC8-71	45915	295
DC8-73CF	45936	344
DC8-71CF	45938	331
DC8-71CF	45939	351
DC8-71	45941	317
DC8-71	45944	326
DC8-71	45945	337
DC8-71	45946	339
DC8-71	45947	341
DC8-71CF	45948	321
DC8-71CF	45949	329
DC8-71CF	45950	354
DC8-71CF	45952	338
DC8-71	45963	355
DC8-73CF	45966	393
DC8-73CF	45967	385
DC8-73CF	45968	389
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DC8-71	45971	356
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DC8-71	45996	397
DC8-71	45997	398
DC8-71	45998	399
DC8-73CF	46001	395
DC8-73CF	46002	394
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DC8-73AF	46004	403
DC8-73AF	46006	413
DC8-73AF	46007	422
DC8-73AF	46008	423
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DC8-73	46033	431
DC8-71	46039	448
DC8-71	46040	449
DC8-72CF	46043	443
DC8-73AF	46044	432
DC8-73CF	46045	441
DC8-73CF	46046	444
DC8-73CF	46047	447
DC8-71	46048	450
DC8-73CF	46049	479
DC8-73CF	46051	440
DC8-73CF	46052	442
DC8-73	46053	446
DC8-71	46055	492
DC8-71	46056	495
DC8-73CF	46059	456
DC8-73CF	46062	486
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Manufacturing Series	Factory Serial Numbers	Fuselage Numbers
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DC8-71	46065	460
DC8-71	46066	462
DC8-72	46067	455
DC8-71	46072	477
DC8-73CF	46073	485
DC8-73AF	46074	468
DC8-73	46076	451
DC8-73AF	46080	466
DC8-72	46081	471
DC8-72	46082	458
DC8-72	46084	473
DC8-73CF	46086	478
DC8-73CF	46087	454
DC8-73CF	46089	501
DC8-73CF	46090	504
DC8-73CF	46091	519
DC8-73CF	46094	482
DC8-73	46095	497
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DC8-73	46100	502
DC8-73CF	46101	489
DC8-73CF	46103	483
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DC8-73CF	46108	522
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CHAPTER 21

GENERAL - DESCRIPTION AND OPERATION

1. Description

A. The airplane has two identical air conditioning systems (left and right) designed for parallel or independent operation to supply conditioned air, cold air, and pressurized air at a controlled volume and pressure. Air supply is furnished by engine bleed air in flight and from either engine bleed air, the auxiliary power unit (APU) if installed, a ground pneumatic supply cart, or from a ground conditioned air supply cart during ground operation. Air conditioning and pressurization are normally accomplished through the operation of both air conditioning systems. The left and right systems are interconnected. The left system normally provides automatic temperature control for the flight compartment, and the right system normally provides temperature control for the passenger compartment. Due to volume difference between the two areas, only a small portion of air supplied by the left system is used for air conditioning in the flight compartment distribution system. The larger part is directed to the passenger compartment distribution system. Separate controls allow independent operation of each system.

B. The flight and passenger compartments are the only areas directly supplied with pressurized, conditioned, and cold air. Pressurized areas and compartment locations are shown in Figure 1. The forward cargo compartment is heated by radio rack exhaust air circulated by the radio rack blower and augmented by hot air from the animal compartment heat shutoff valve. The aft cargo compartment is heated by passenger compartment exhaust air circulated by the aft cargo compartment blower. Cargo compartment heating is accomplished by flowing air through the gap between the cargo compartment floor and the airplane skin insulation. There is no continuous airflow through the cargo compartments. Cargo compartment pressure equalization valves are installed in the ceiling of each cargo compartment to maintain pressure within the compartments equal to passenger compartment pressure.

C. Each air conditioning system delivers conditioned air when the air conditioning systems are operating (see Figure 2), but each function of the system is controlled and monitored by separate subsystems. To segregate these functions, air conditioning is divided into pressure source, distribution, pressurization control, heating, cooling, and temperature control.

D. Pressure Source (See Figure 3.)

(1) Whenever the airplane engines are operating, the normal source of air for compartment conditioning and pressurization will be engine

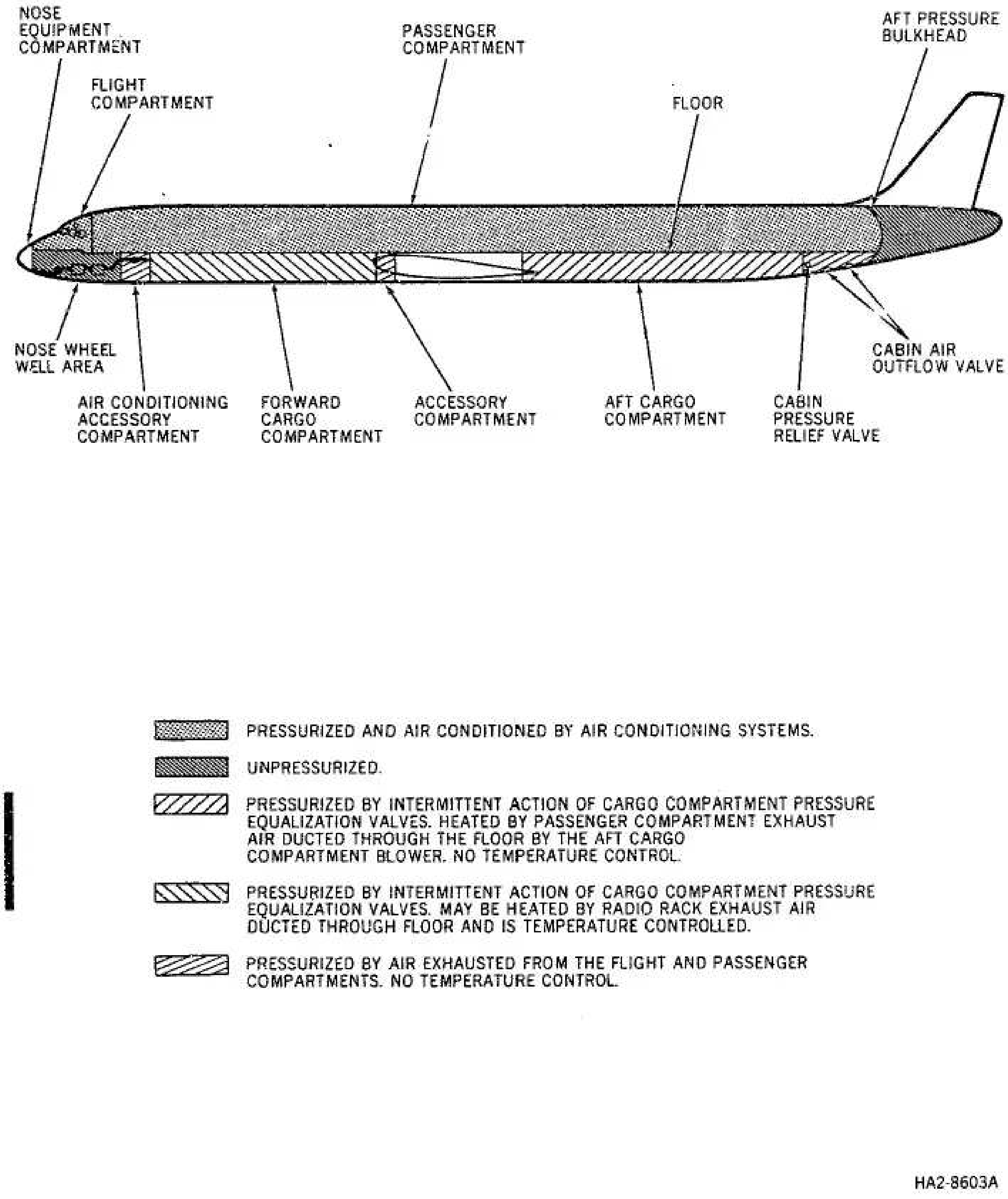
compressor bleed. For normal operation all engines will be bled, with the crossover valve closed so that each pack is fed by the engines on the adjacent wing. Fifth stage bleed air pressure is adequate to meet system demand during aircraft takeoff, climb and cruise conditions; but during some conditions of low power settings, ninth stage air is automatically employed to provide the necessary system operating pressure.

(2) Since it is undersirable to subject ducts inside an aircraft fuselage to bleed air temperature above 482°F, bleed air temperature must be controlled. Therefore, all bleed air from 9th stage and/or 5th stage is first routed through the engine bleed air regulator valve and a bleed air precooler. Engine fan airflow through the precooler is regulated by a self-contained thermostatically controlled and pneumatically actuated precooler valve. This self-contained control valve is designed to control the bleed air temperature, downstream of the heat exchanger, within the range of 374°F (190°C) to 482°F (250°C) whenever de-icing air is required. When no de-icing air is being utilized, the temperature out of the precooler may be lower than 374°F.

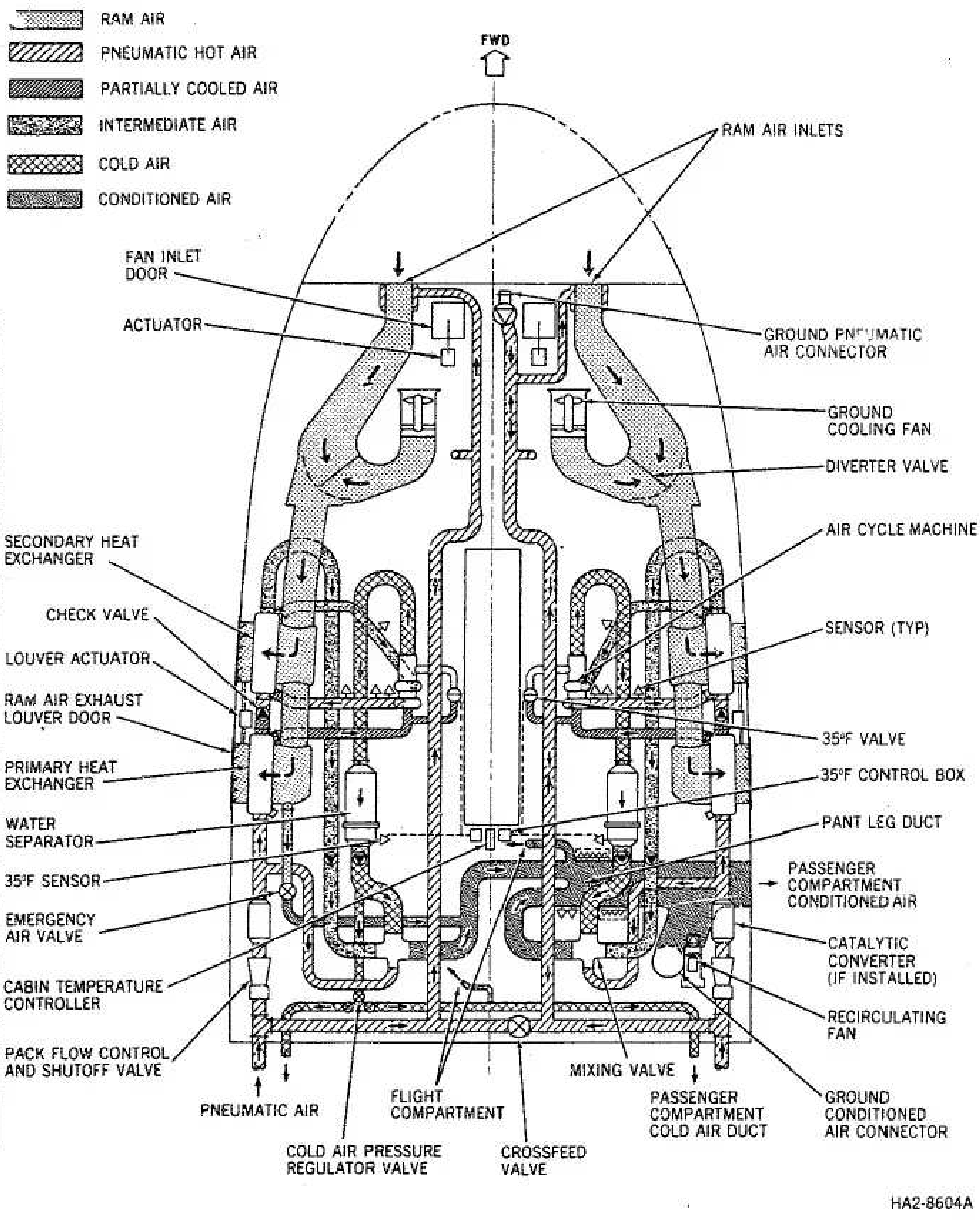
(3) Each air conditioning pack has a flow control/shutoff valve. The flow control/shutoff valve, located in the air conditioning accessory compartment just inside the pressure bulkhead, serves as a pack shutoff valve in addition to its flow control function. The flow control valves are activated by the left and right pack switches on the systems engineer's control panel.

(4) The pack flow selector switch is provided to save airplane bleed air penalty during cruise operation with less than a full load capacity. The flow control valve regulates and controls the airflow at all times that the system bleed air pressure is high enough to satisfy the flow requirements. The flow control valve is also equipped with a variable flow rate selection function. A rotary five-position selector switch for each flow control valve is provided on the systems engineer's control panel. This switch allows the selection of five separate flow schedules of aircraft fresh air ventilation. The maximum flow position provides a pack airflow rate of about 103.6 lb. per min for a 5000 ft. cabin with a bleed air manifold temperature of 330°F. This would provide approximately 3100 cubic feet per minute in the passenger cabin. If 250 passengers were onboard, this would correspond to 12.4 cu
R ft/min/passenger of fresh air in addition to 5.3 cu ft/min/passenger of recirculated air. Each of the remaining four switch positions on the pack flow selector reduces the scheduled maximum flow rate curve by about 10 percent per step. Therefore, the minimum flow position provides a flow rate of 1860 cu ft/min of fresh air to the cabin, the same fresh air rate per passenger for 150 passengers as the maximum flow rate supplied for 250 passengers.

(5) Both flow control valves will be closed automatically if the temperatures in the air cycle machine circuit exceed safe operating limits.



Pressurized Areas and Compartment Locations
Figure 1



Air Conditioning System -- Schematic
Figure 2

E. Distribution

(1) Air conditioning distribution utilizes two entirely independent systems. The individual air distribution system routes only the cold air from the left air conditioning pack to individually regulated outlets in the flight and passenger compartments. The conditioned air distribution system routes the mixture of hot and cold air to the passenger and flight compartments.

(2) The individual air distribution system provides each crewmember and passenger a method for cooling his local area to a value different from that provided by the normal air conditioning automatic control. Air is received from the cold side of the left temperature control mixing valve and is ducted to each individual station. An adjustable nozzle at each station allows the individual a choice anywhere between no supplementary cold air and full system capacity cold air.

(3) The conditioned air distribution system directs the flow of ram air, hot air, warm air, cold air, conditioned air, and exhaust air. The left-hand system normally supplies the small amount of conditioned air used by the flight compartment. The remainder of the air from the left-hand system is combined with the right-hand system and delivered to the passenger compartment.

(4) The recirculating fan provides air recirculation from the air conditioning accessory compartment, through the recirculating fan wye duct, to the distribution system (see Figure 4). The recircul tion fan will be ON normally but may be turned OFF when the airplane is in the "pull down" condition prior to passenger loading. The fan is inoperative during ground conditioned air service cart operation.

(5) In an emergency, ram air can be used for cabin ventilation. This air is supplied from the lefthand ram air ducting through a manually actuated shutoff valve. This valve is manually operated by a push-pull T-handle located in the flight compartment behind the observer's seat.

(6) Distribution system components consist of ducts, check valves, mufflers and exhaust vents, which are necessary to direct and control air distribution throughout the airplane. Each component functions individually to perform a particular requirement within the distribution system.

F. Pressurization Control

(1) The pressurization control system (see Figure 5) is designed to maintain the pressurized areas of the airplane at a pressure altitude of sea level while the airplane is at an altitude of sea level to 23,000 feet, and at a pressure altitude of 6700 feet while the airplane is at an altitude of 40,000 feet. These pressures impose a normal cabin-to-atmosphere pressure differential up to 8.77 psi on the airplane structure.

Pressurization is accomplished by discharging the output of the air conditioning system into the passenger and flight compartments and limiting the amount of exhaust air by opening and closing the cabin air outflow valve.

(2) Normal operation is automatic after selecting the desired cabin altitude and cabin rate-of-change on the cabin pressure controller. Manual control is possible by physical operation of the cabin air outflow valve manual control and indicating lever. The pressurization control system is monitored by the cabin altitude and differential pressure indicator and the cabin rate-of-climb indicator. A cabin low-pressure warning horn sounds intermittently when cabin pressure altitude exceeds approximately 10,000 feet. Two cabin pressure safety valves are set to relieve pressure if the pressure differential exceeds 8.82 psi.

G. Heating

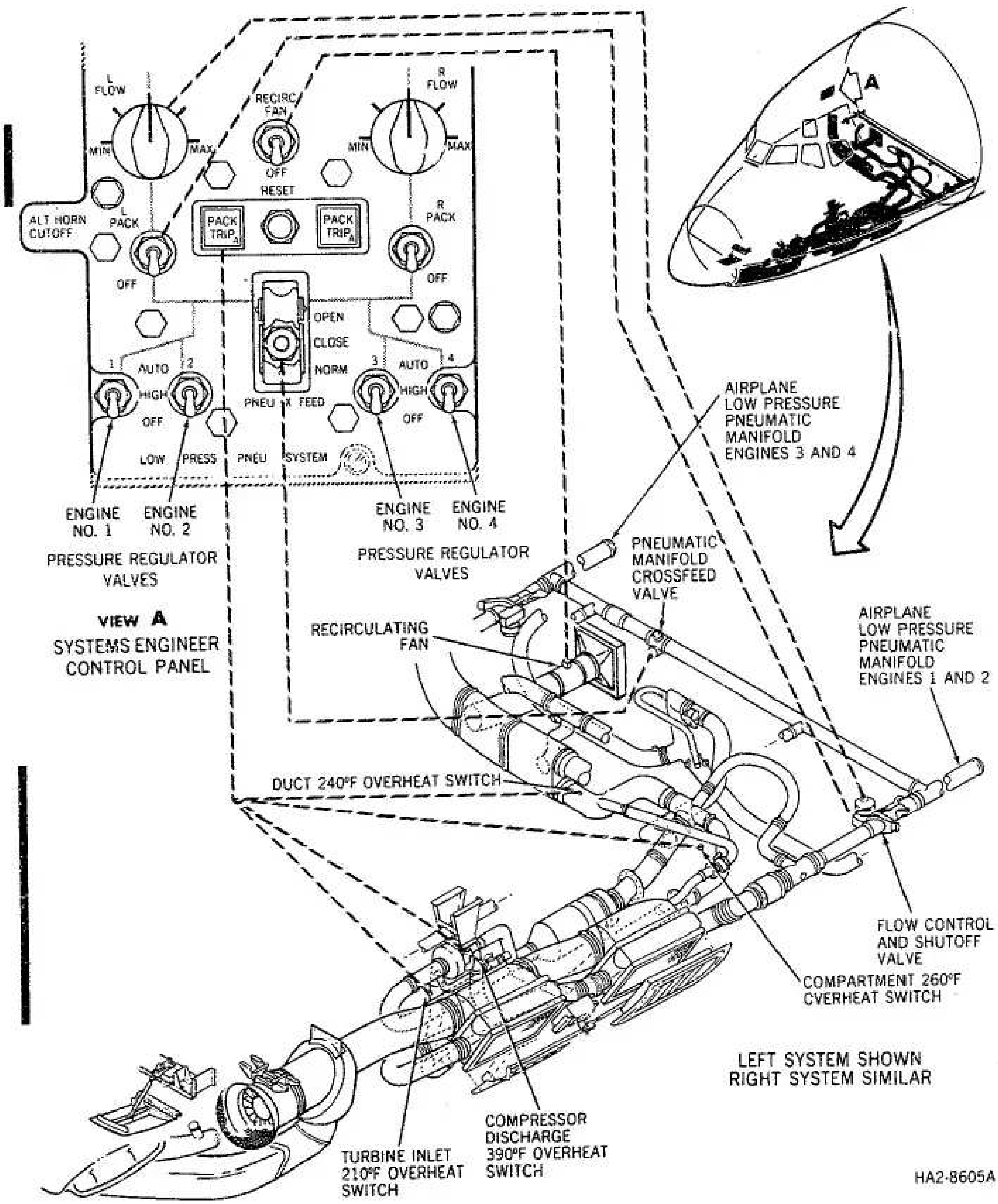
(1) Flight compartment floor heating panels and fluted fiberglass panels are provided to warm the flight compartment floor, since the floor is exposed to ambient air temperature conditions. Conditioned air is passed through the fluted panels and is exhausted at floor level near the captain's and first officer's feet to help keep the immediate area warm. There are eight electrically operated flight compartment floor heating panels. Two panels are located in the navigator's area, four in the systems engineer's area, and one each in the captain's and first officer's areas.

(2) The floor heating panels are in operation whenever the airplane electrical load buses are energized and the cockpit heater circuit breakers are closed.

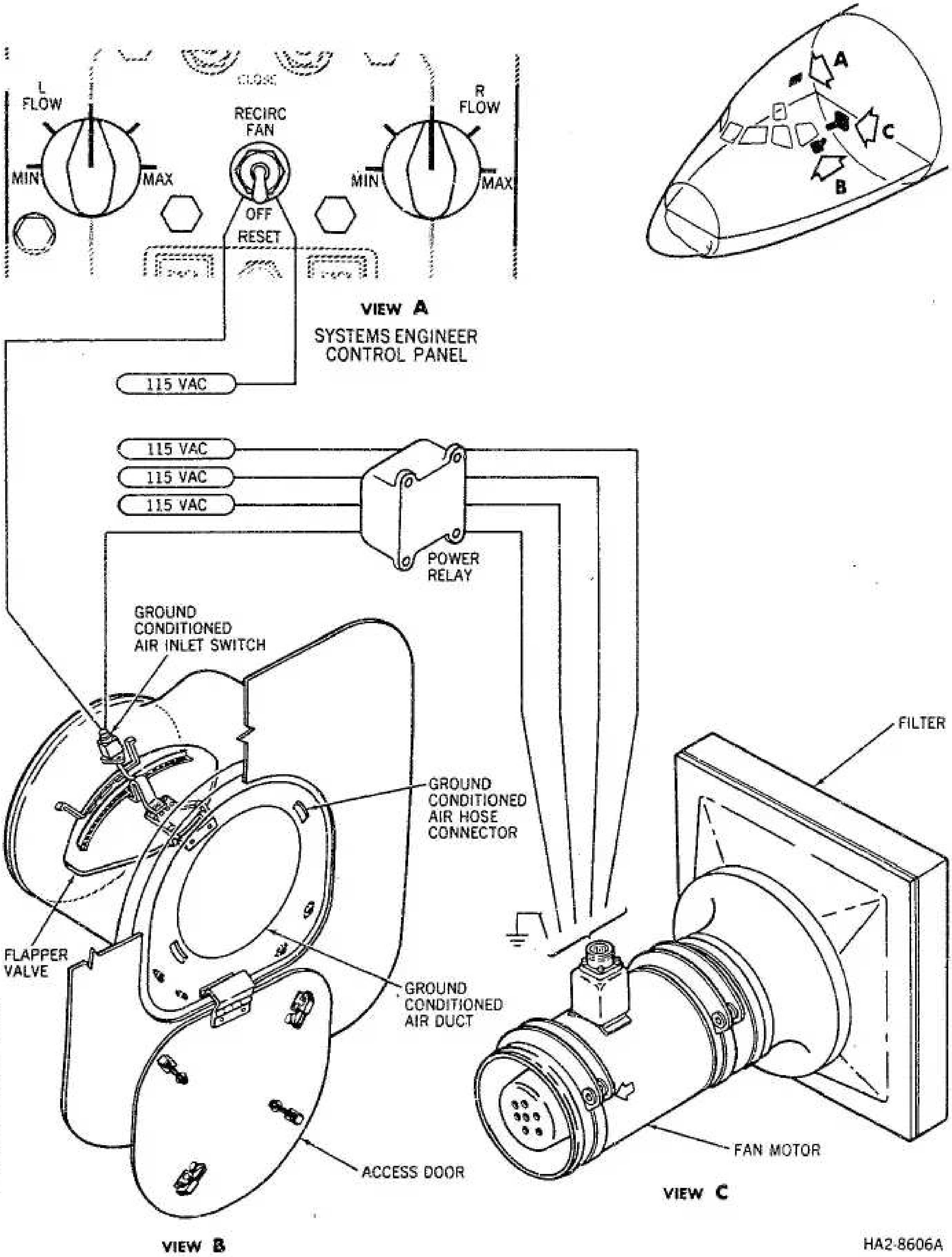
(3) The forward cargo compartment heating is secondary to the radio rack cooling. Additional heated air is supplied to the animal compartment from the pneumatic manifold through the animal compartment shutoff valve and is temperature controlled. The aft cargo compartment heating is secondary to the passenger compartment heating and is not temperature controlled.

H. Cooling

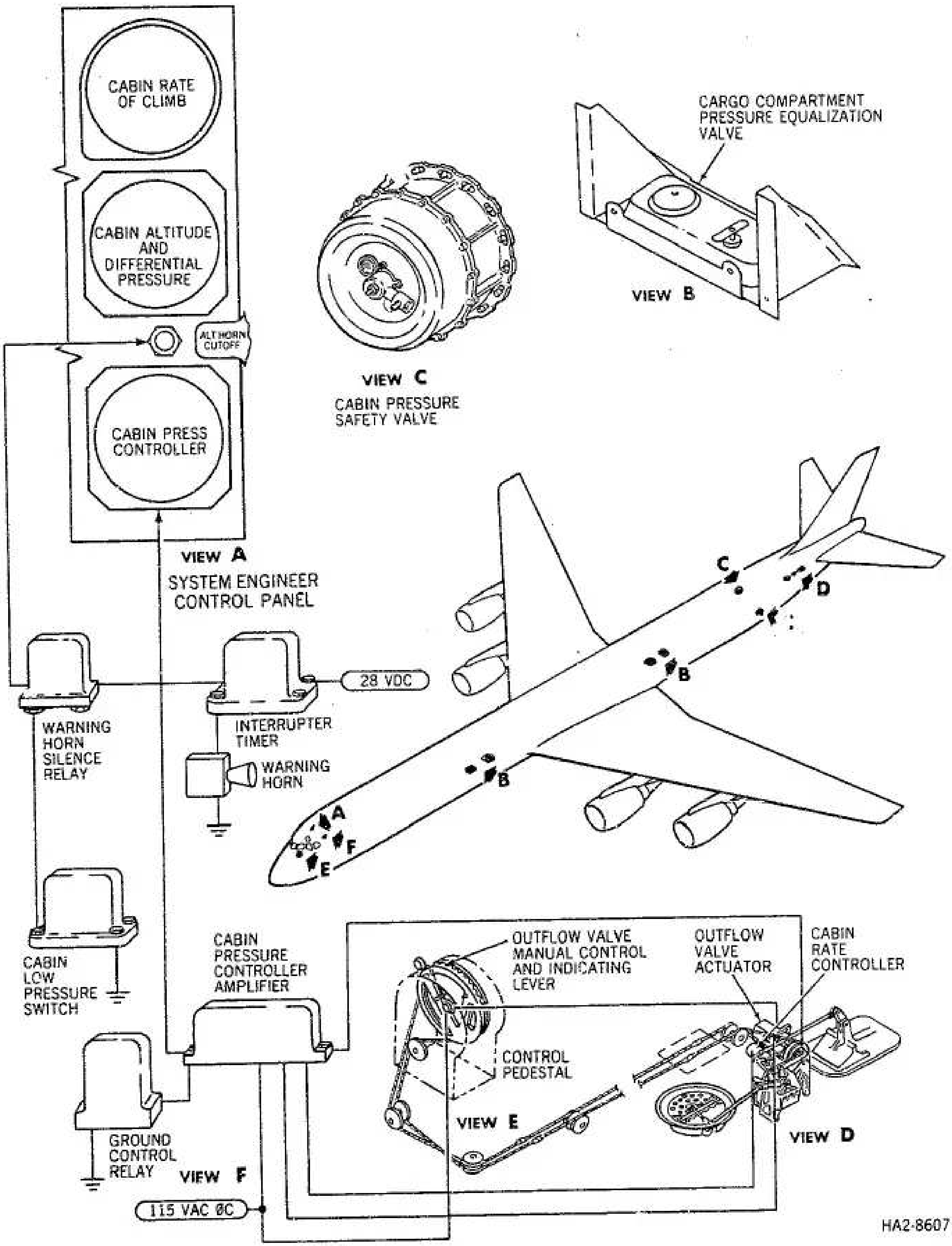
(1) The cooling systems for the airplane are; cooling packs, ram air system, radio rack control, and air-conditioning temperature control. The right and left air conditioning packs systems, which are independent of each other (see Figure 2), provide air-conditioning cooling in flight and give total cooling on the ground. Two distinct operational functions take place in each system. These are the mechanical function of the cooling cycle and the electrical function to stop, start, protect, and monitor system operation.



Air Conditioning Pressure Source--Operation
Figure 3



Recirculating Fan -- Operation
Figure 4



Pressurization Control -- Operation
Figure 5

(2) All cold air required is provided by two air conditioning packs. Passing bleed air through a primary heat exchanger, an air cycle machine, and a secondary heat exchanger cools the air sufficiently to provide a cooling medium with temperature low enough to handle any cooling situation required. The ram air system provides coolant air for the heat exchangers. A water separator removes excess moisture from the cooled air. Various thermal switches, thermostats, sensors, and valves are included with the pack to provide automatic protection for the packs, and warning against pack malfunction. Ram air cooling doors may be adjusted to increase or decrease airflow through the heat exchangers by switches on the systems engineer's control panel. A cooling door position indicator is also provided.

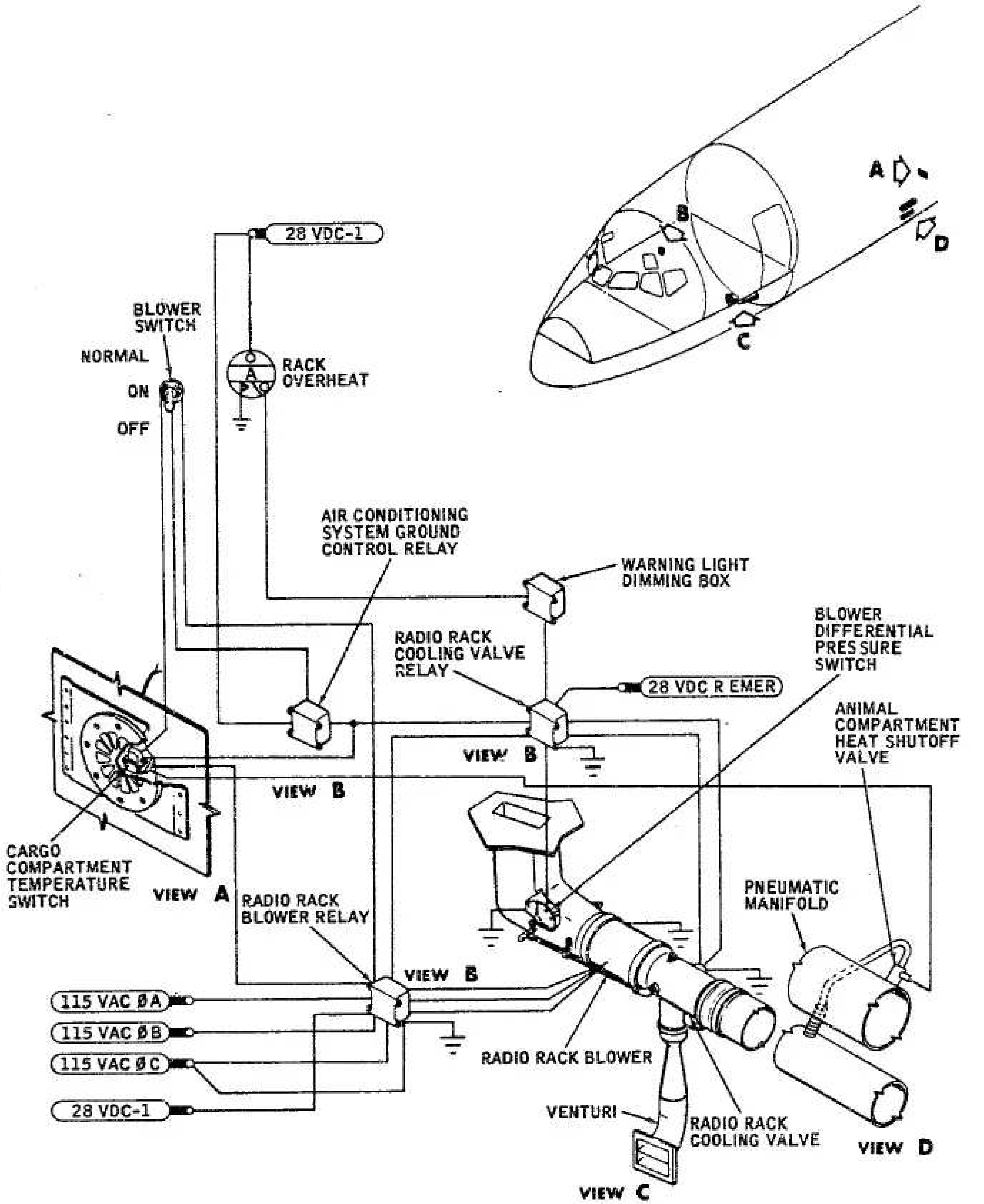
(3) The radio rack cooling system (see Figure 6) controls and directs the flow of flight compartment exhaust air to ventilate and cool the electrical and electronic equipment, and heat the forward lower cargo compartment augmented by the animal compartment heat shutoff valve. The venturi, ducts, and baffled air passages, together with the radio rack blower and radio rack cooling valve, are arranged so that the necessary amount of cooling air is available for the installed equipment. Flow of exhaust air from the flight compartment prevents concentrations of smoke in the flight compartment if equipment becomes overheated. The radio rack is shrouded and connected by ducts to the radio rack blower, which operates continuously when the airplane electrical buses are energized. After performing the radio rack cooling function, the air is normally circulated between the forward cargo compartment floor and airplane insulation.

(4) Ram airflow across the air-conditioning heat exchanger (see Figure 7) is controlled by opening and closing the exhaust louver with electrical actuators. The air-conditioning pack cooling door switch controls the direction and degree of rotation of the exhaust louver actuator. The position meters indicate the door position between close and open and are used to aid in rapidly establishing the proper cooling door position. The ram air cooling door control and position indicators are utilized in conjunction with the compressor outlet temperature meters to maintain proper air temperatures to the air cycle machine.

(5) Primary and secondary heat exchanger cooling airflow is provided by
R a ground cooling fan for all ground operations. In normal flight cooling airflow is supplied by ram air. A heat exchanger system is installed in each air conditioning system.

J. Temperature Control

(1) Temperature of the air entering the passenger and flight compartments (see Figure 8) is regulated by positioning the air mix valves. The mix valves provide three different flow patterns of air for air conditioning. The mix valve combines hot air from the pneumatic system,



NOTE: A = AMBER

HA2-8608

Radio Rack Cooling -- Operation
Figure 6

cold air which has gone through the heat exchangers and air cycle machine, and air cycle machine bypass air only through the primary and secondary heat exchangers. The amount of airflow through the mix valves is regulated by the temperature control system. There is one mix valve for each air conditioning pack (see Figure 8). Two sets of controls on the systems engineer's control panel provide automatic or manual control and system monitoring for each pack. The flight compartment controls apply to the left pack and the passenger compartment controls the right pack. Each control system consists of a temperature regulator, temperature sensor, overheat control and warning light, and mix valve position indicator.

2. To Operate System

A. General

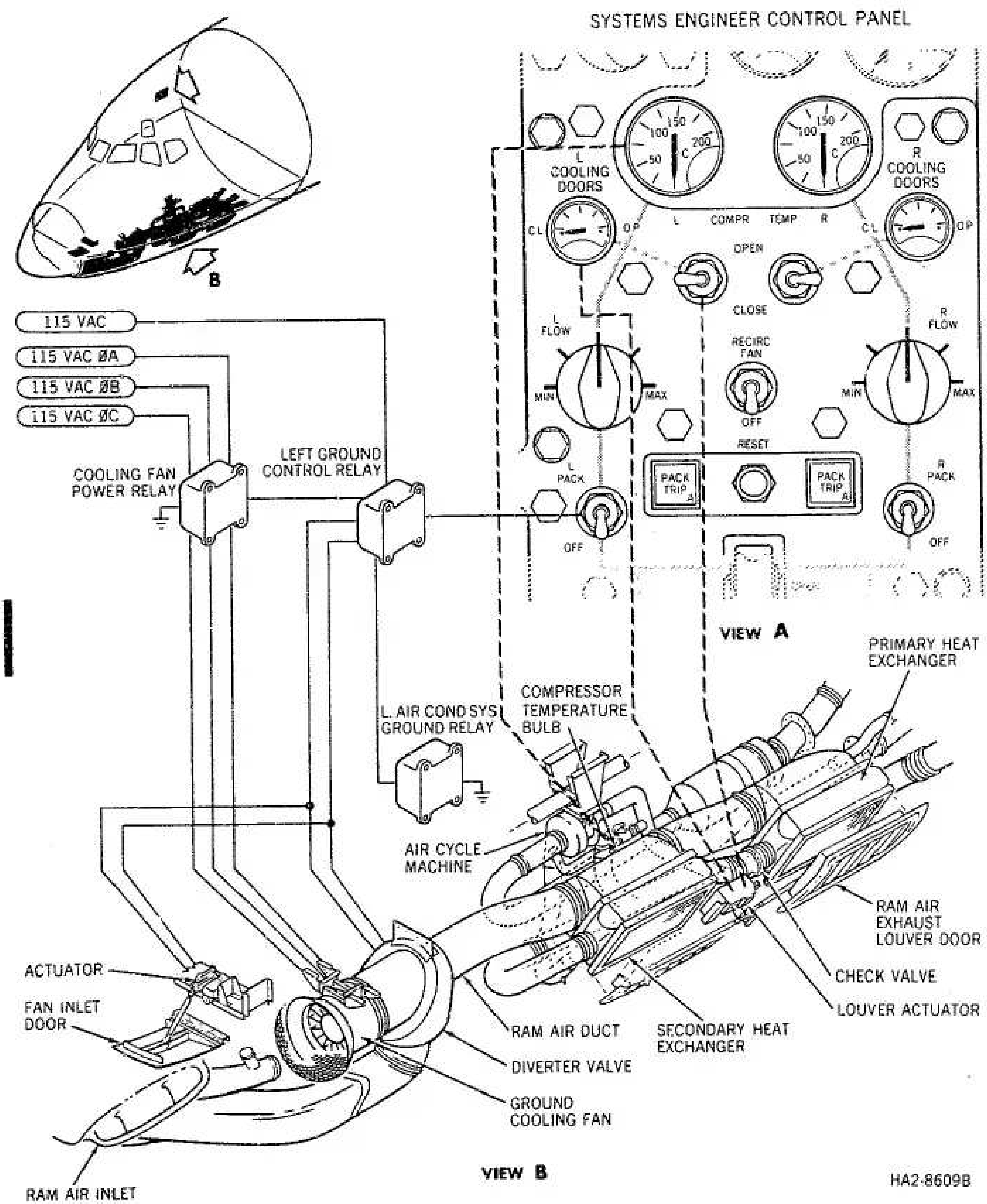
(1) Power may be supplied to the air conditioning system from an external source or from an operating engine. Sufficient pneumatic and electrical power is available to operate the air conditioning systems when the engines are operating at idle. Ground power required to operate the air conditioning systems at maximum capacity is given in Figure 9.

(2) The amount of cooling provided by the air conditioning systems is dependent upon air source flow rate pressure and temperature, and upon ambient temperature and humidity. With 224 pounds per minute of air supplied from a ground cart at 35 psig and 450°F, with both air conditioning systems operating, but without the recirculating fan operating, the airplane can be cooled on a "hot" day from an initial cabin temperature of 110°F, to 75°F in approximately 25 minutes. A "hot" day is specified as an ambient temperature of 103°F and a humidity of 118 grains of water per pound of dry air.

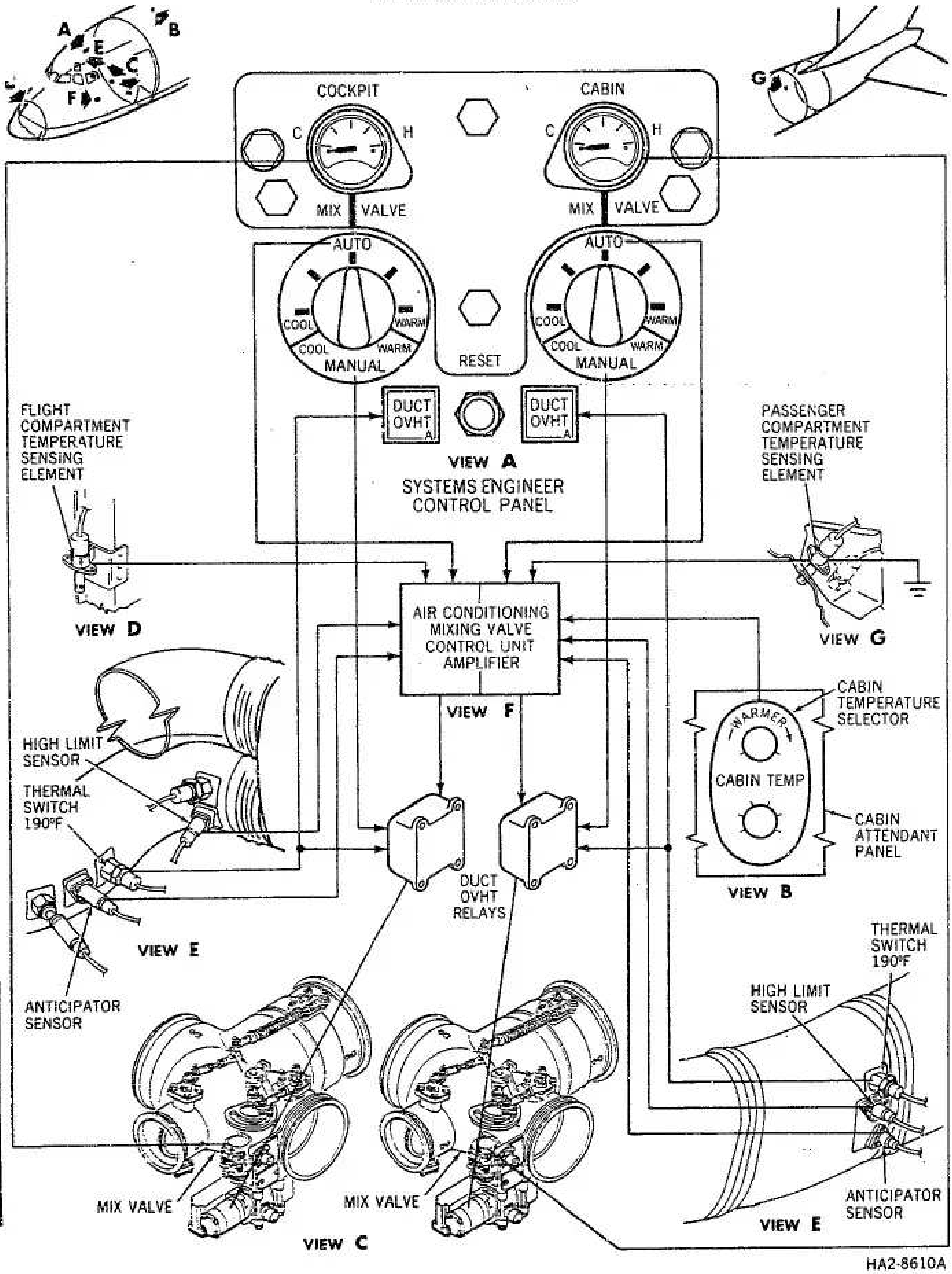
(3) Each air conditioning system is controlled and monitored from the systems engineer control panel in the flight compartment. Circuit breakers necessary for operation of the air conditioning system packs, valves, shutdown circuits, and warning indicators are listed in Figure 10. The controls and indicator functions are listed in Figures 11 and 12.

B. Ground Pneumatic Supply Requirements

(1) The temperature of the air supplied to the airplane pneumatic system directly affects the efficiency and service life of certain airplane system components. Ice formation in the discharge air from the air cycle machine turbine or compressor affects performance and control, and causes erosion in the turbine. Maintaining a minimum temperature of 160°F (71°C), at a pressure of 30 to 40 psig, at the fuselage nose ground pneumatic connector prevents ice formation.



Ram Air Control -- Operation
Figure 7



Temperature Control -- Operation
Figure 8

(2) Oil entrained in the supply air picks up dirt; and, when in contact with hot machine parts, forms gum and hard deposits which affect friction and cause pressure drops in control orifices. At 160°F (71°C) oil is still in liquid form, but at 450°F (232°C) most of the oil remains vaporized throughout the cycle. Because even a 10-micron, entrapment-type filter cannot be depended upon to filter out all oil, centrifugal compressors, and reciprocating compressors with carbon piston rings, are preferred as ground pneumatic sources. All ground sources, except centrifugal compressors, must incorporate a 10-micron filter, and all ducting downstream of the filter must be maintained scrupulously free of rust and dirt particles. To reduce airflow requirements and to maintain residual oil in the entrained condition, the temperature of the supply air as delivered to the ground connector should be maintained at the highest value the airplane system involved can accept. Ground supply air can be applied to the ground connector at a maximum temperature of 460°F (237°C) except when the deicing system is operating (see Chapter 30).

Operation	Ac Electrical Power	Pneumatic Power
One air-conditioning system	90-120 amperes at 115-volt, 3-phase, 400-hertz, for 10 second start and 33 (±5) amperes for normal operation.	Flow - 65-120 lb/min Pressure - 30-38 psig Temperature - 330° to 450°F (165.6° to 237.7°C)
Both air-conditioning systems	66 amperes at 115-volt, 3-phase, 400-hertz for normal operation.	Flow - 130-240 lb/min Pressure - 30-38 psig Temperature 330° to 450°F (165.6° to 237.7°C)

Air-Conditioning System Power Requirements
Figure 9

NOTE: When one air-conditioning system is first turned on, the initial load is approximately 105 amperes for ten seconds. Normal operating load for one system is approximately 33 amperes. When the other air-conditioning system is turned on the total initial load is approximately 130 amperes for ten seconds. Normal operating load with both systems operating is approximately 66 amperes.

Circuit Breaker	Panel Section
Ground control relay	Miscellaneous (ac bus)
Pack and supply air temperature indicator	Heat, vent, and ice protection (dc bus)
Recirculating fan protection	Heat, vent, and ice protection (dc bus)
Left water separator 35°F Control	Heat, vent, and ice protection (ac bus)
Recirculating fan control	Heat, vent, and ice protection (ac bus)
Right water separator 35°F Control	Heat, vent, and ice protection (ac bus)
Cabin temperature indicator	Heat, vent, and ice protection (dc bus)
Aft cargo compartment blower phase A	Aft cabin electrical panel
Aft cargo compartment blower phase B	Aft cabin electrical panel
Aft cargo compartment blower phase C	Aft cabin electrical panel
Cabin pressure control	Heat, vent, and ice protection (ac bus)
Takeoff and cabin low pressure warning	Miscellaneous dc bus 1
Cockpit auto temperature control	Heat, vent, and ice protection (ac bus)
Cabin auto temperature control	Heat, vent, and ice protection (ac bus)
Pack control left	Heat, vent, and ice protection (dc bus)
Pack control right	Heat, vent, and ice protection (dc bus)
Duct overheat left	Heat, vent, and ice protection (dc bus)

Air Conditioning System Circuit Breakers
Figure 10 (Sheet 1)

	Circuit Breaker	Panel Section
	Duct overheat right	Heat, vent, and ice protection (dc bus)
R	Pack trip right	Battery bus direct (dc bus)
R	Pack trip left	Battery bus direct (dc bus)
	Cockpit manual temperature control	Heat, vent, and ice protection (ac bus)
	Cabin manual temperature control	Heat, vent, and ice protection (ac bus)
	Pack compressor temperature indicator	Heat, vent, and ice protection (dc bus)
	Pack valve position indicator	Heat, vent, and ice protection (dc bus)
	Radio rack blower phase A	Miscellaneous (ac bus)
	Radio rack blower phase B	Miscellaneous (ac bus)
	Radio rack blower phase C	Miscellaneous (ac bus)
	Animal Compartment Heat Shutoff Valve	Miscellaneous (dc bus 1)
	Radio rack blower warning	Miscellaneous (dc bus 1)
	Radio rack cooling	Right dc emergency bus
	Pack vane door control left	Heat, vent, and ice protection (ac bus)
	Pack vane door control right	Heat, vent, and ice protection (ac bus)
	Pack cooling fan control left	Heat, vent, and ice protection (ac bus)
	Pack cooling fan control right	Heat, vent, and ice protection (ac bus)
	Systems engineer's panel red light	Lighting, (ac bus)
	Cabin pressure door control	Heat, vent, and ice protection (ac bus)
	Manifold air temperature indicator	Heat, vent, and ice protection (dc bus)

Air Conditioning System Circuit Breakers
Figure 10 (Sheet 2)

Control	Function
Low pressure pneumatic shutoff switches 1, 2, 3, and 4	
Auto position	Bleed air system on that engine maintains 38 psig nominal, automatically switching from 5th to 9th stages as required
High position	The automatic system is overridden and 9th stage supplies air whenever 5th stage pressure is below the high stage regulating setting (approximately 45 psig).
Off position	All air from that engine is terminated
Pneumatic crossfeed valve control switch	
Open position	The valve is maintained in an open condition so that the bleed air manifold is continuous from wing to wing
Close position	The valve is maintained in a closed condition so that the bleed air manifold is divided in half at the cente line of the airplane
Norm position	The valve is essentially closed in flight and open on the ground and is repositioned between these conditions automatically
Flow control/shutoff switches L PACK and R PACK	
On position	The flow control valve for that particular pack is activated to provide controlled air-flow to the air conditioning system
Off position	The flow control valve closes and no pack flow exists

Air Conditioning System Controls
Figure 11 (Sheet 1)

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Control	Function
Pack trip reset push button switch	When the left or right pack trip light comes on, the flow control valve will close. The flow control valve can be reopened, and the pack trip light goes off only if the condition causing the trip has returned to normal conditions, and the reset push button has been activated
Pack flow selector five position rotary switches left and right	
Maximum position	The flow control for the particular pack controls the pack flow to the maximum ventilation rate schedule automatically
Intermediate positions	Rotating the switch counterclockwise toward MIN reduces the flow schedule approximately 10 percent per step
Minimum position	Pack flow schedule reduced to approximately 60 percent of the maximum schedule
Recirculating fan switch	
Recirc fan position	Normal position and turns the recirculating fan on
Off position	The recirculating fan may be turned off on the ground
Left and right cooling doors control switches	
Open position	Momentary position to move the heat exchanger ram air cooling exit louvers toward the open position
Center position	Spring loaded to center stops operation of cooling doors
Close position	Momentary position to move the heat exchanger ram air cooling exit louvers toward the close position

Air Conditioning System Controls
Figure 11 (Sheet 2)

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DOUGLAS AIRCRAFT CO., INC.
DC-8 SEVENTY SERIES
MAINTENANCE MANUAL

Control	Function
Temperature indicator selector switch	
Left pack position	Monitors left pack output air temperature
Right pack position	Monitors right pack output air temperature
Cabin supply position	Monitors cabin supply air temperature
Cargo compartment position (if applicable)	Monitors cargo compartment temperature
Duct overheat reset push button switch	When the flight or passenger compartment duct overheat light comes on, the respective temperature control valve is driven in a direction to produce maximum cooling. Once the condition causing the overheat has been alleviated and the reset button has been activated, the light will go off and the system will return to normal
Temperature selectors flight and passenger compartment	
Automatic temperature control selection	Temperature controls are energized and the selected temperatures are controlled automatically
Cool position	Corresponds to a flight or passenger compartment temperature of approximately 65°F
Warm position	Corresponds to a flight or passenger compartment temperature of approximately 85°F
Manual position	The automatic temperature control is de-energized and the temperature control valves at the output of each pack are controlled directly by manipulation of the manual switch

Air Conditioning System Controls
Figure 11 (Sheet 3)

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Control	Function
Cool position	Momentary position to move the temperature control valve toward cool
Down position	Spring loaded to the 6 o'clock position and the temperature control valve remains in the last position
Warm position	Momentary position to move the temperature control valve toward warm
Cabin pressure controller	
Altitude selector knob (normal or retracted position)	Set desired cabin altitude in feet as indicated in window
Altitude selector knob (pulled out position)	Set airport barometric pressure in inches of mercury or millibars
Rate control knob	Set desired cabin rate of climb in feet per minute
Cabin air outflow valve manual control and indi-lever	With knob in normal position, lever indicates position of cabin air outflow valve in automatic mode. With knob on lever lifted and turned 90 degrees, lever manually controls position of cabin air outflow valve
Altitude horn cutoff switch	Silence takeoff and cabin low-pressure warning horn
Blower switch	
Normal (guarded) position	Energize blower circuits and radio rack cooling valve close circuits when airplane is on ground; energize blower circuits, radio rack cooling valve, and animal compartment heat shut-off valve circuits in flight when temperature of forward cargo compartment is between 60° and 75°F
Off position	Deenergize blower and energize radio rack cooling valve open circuits
On position	Energize blower and radio rack cooling valve close circuits

Air Conditioning System Controls
Figure 11 (Sheet 4)

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DOUGLAS AIRCRAFT CO., INC.
DC-8 SEVENTY SERIES
MAINTENANCE MANUAL

Indicator	Function
Pack trip lights left and right	The left or right light is activated and the flow control valve is closed automatically due to the flight compartment (left pack) or passenger compartment (right pack) inlet ducts have exceeded 240°F, or, the turbine inlet of the air cycle machine has exceeded 210°F, or, the compressor outlet of the air cycle machine has exceeded 390°F, or temperature in air conditioning tunnel exceeds 260°F
Left and right cooling doors indicators	Indicate the louver door position between closed and open and used in rapidly establishing the proper cooling door position
Compressor temperature indicator left and right	Indicates air cycle machine compressor outlet temperature
Temperature indicator	Indicates temperatures as selected by the temperature indicator selector switch
Cabin temperature indicator	Indicates passenger compartment temperature
Cockpit and cabin mix valve position indicators	Indicates the position of the respective mixing valve between cold and hot and is especially useful if the temperature selector is in the manual mode
Cabin altitude and differential pressure indicator	Indicate cabin altitude in feet and cabin-to-atmosphere differential pressure
Cabin rate-of-climb indicator	Indicate rate-of-climb of cabin altitude in feet per minute.
Takeoff and cabin low-pressure warning horn	Sound when airplane cabin altitude is approximately 9500 to 10,000 feet
Radio rack overheat indicator	Indicator lights when less than 2 1/2 psi is sensed across radio rack blower duct and blower circuit is energized

Air Conditioning System Indicators
Figure 12

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C. Pressure and Airflow Requirements

(1) The airplane pneumatic manifold can be pressurized from either the compressors of the airplane engines, the APU, or a ground pneumatic source. When the manifold is pressurized from the engines, the engine power and the airplane pneumatic system automatically control manifold temperature and pressure (see Chapter 36). When the manifold is pressurized from a ground pneumatic source that is applied to the fuselage nose ground pneumatic connector, the manifold pressure should be kept above 13 psig as indicated by the flight compartment manifold pressure indicator.

(2) Normal manifold leakage permits the decay of airplane manifold pressure after the ground pneumatic source is shut off. Rapid relief of manifold pressure can be effected by operating any air-consuming airplane system, except the air conditioning packs, provided the ground pneumatic source is first shut off.

D. Air Conditioning System Preparation for Starting

NOTE: Circuit breakers that control operation of valves, overheat shutdown circuits, and warning circuits of the air conditioning system are listed in Figure 10.

(1) Position switches and controls as follows:

Control	Position
Pack switches	Off
Flow selectors	Up
Low-pressure pneumatic manifold crossfeed valve switch	Norm
Recirculating fan switch	Off
Low press pneu system switches	Auto
Cooling doors indicators	Open
Air conditioning temperature selectors	Automatic mode (center dot)
Temperature indicator selector	Cabin supply
Cabin air outflow valve manual control and indicating lever	Automatic mode (unlocked position)

NOTE: The cabin pressure control system is in the automatic mode when the cabin air outflow valve manual control and indicating lever knob is parallel with the control quadrant. The cabin pressure control system is in the manual mode when the manual control and indicating lever knob is extended and turned 90 degrees, allowing the lever to be locked in any position over the operating range.

(2) Pressurize airplane pneumatic manifold (see Chapter 36).

(3) Check for minimum of 13 psig on pneumatic manifold air pressure indicator.

E. Start Air Conditioning System

(1) Perform air conditioning start preparation.

(2) Place PACK switch in the up position. Observe pack start by an increasing COMPR TEMP indication.

(3) Place cabin attendants temperature selector on cabin attendants electrical panel in central position.

(4) Verify temperatures using the temperature indicator selector switch.

(5) Verify cabin temperature indication.

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CHAPTER 21

GENERAL - DESCRIPTION AND OPERATION

1. Description

A. The airplane has two identical air conditioning systems (left and right) designed for parallel or independent operation to supply conditioned air, cold air, and pressurized air at a controlled volume and pressure. Air supply is furnished by engine bleed air in flight and from either engine bleed air, the auxiliary power unit (APU) if installed, a ground pneumatic supply cart, or from a ground conditioned air supply cart during ground operation. Air conditioning and pressurization are normally accomplished through the operation of both air conditioning systems. The left and right systems are interconnected. The left system normally provides automatic temperature control for the flight compartment, and the right system normally provides temperature control for the passenger compartment. Due to volume difference between the two areas, only a small portion of air supplied by the left system is used for air conditioning in the flight compartment distribution system. The larger part is directed to the passenger compartment distribution system. Separate controls allow independent operation of each system.

B. The flight and passenger compartments are the only areas directly supplied with pressurized, conditioned, and cold air. Pressurized areas and compartment locations are shown in Figure 1. The forward cargo compartment is heated by radio rack exhaust air circulated by the radio rack blower and augmented by hot air from the animal compartment heat shutoff valve. The aft cargo compartment is heated by passenger compartment exhaust air circulated by the aft cargo compartment blower. Cargo compartment heating is accomplished by flowing air through the gap between the cargo compartment floor and the airplane skin insulation. There is no continuous airflow through the cargo compartments. Cargo compartment pressure equalization valves are installed in the ceiling of each cargo compartment to maintain pressure within the compartments equal to passenger compartment pressure.

C. Each air conditioning system delivers conditioned air when the air conditioning systems are operating (see Figure 2), but each function of the system is controlled and monitored by separate subsystems. To segregate these functions, air conditioning is divided into pressure source, distribution, pressurization control, heating, cooling, and temperature control.

D. Pressure Source (See Figure 3.)

(1) Whenever the airplane engines are operating, the normal source of air for compartment conditioning and pressurization will be engine

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compressor bleed. For normal operation all engines will be bled, with the crossover valve closed so that each pack is fed by the engines on the adjacent wing. Fifth stage bleed air pressure is adequate to meet system demand during aircraft takeoff, climb and cruise conditions; but during some conditions of low power settings, ninth stage air is automatically employed to provide the necessary system operating pressure.

(2) Since it is undersirable to subject ducts inside an aircraft fuselage to bleed air temperatures above 482°F, bleed air temperature must be controlled. Therefore, all bleed air from 9th stage and/or 5th stage is first routed through the engine bleed air regulator valve and a bleed air precooler. Engine fan airflow through the precooler is regulated by a self-contained thermostatically controlled and pneumatically actuated precooler valve. This self-contained control valve is designed to control the bleed air temperature, downstream of the heat exchanger, within the range of 374°F (190°C) to 482°F (250°C) whenever de-icing air is required. When no de-icing air is being utilized, the temperature out of the precooler may be lower than 374°F.

(3) Each air conditioning pack has a flow control/shutoff valve. The flow control/shutoff valve, located in the air conditioning accessory compartment just inside the pressure bulkhead, serves as a pack shutoff valve in addition to its flow control function. The flow control valves are activated by the left and right pack switches on the systems engineer's control panel.

(4) The pack flow selector switch is provided to save airplane bleed air penalty during cruise operation with less than a full load capacity. The flow control valve regulates and controls the airflow at all times that the system bleed air pressure is high enough to satisfy the flow requirements. The flow control valve is also equipped with a variable flow rate selection function. A rotary five-position selector switch for each flow control valve is provided on the systems engineer's control panel. This switch allows the selection of five separate flow schedules of aircraft fresh air ventilation. The maximum flow position provides a pack airflow rate of about 103.6 lb. per min for a 5000 ft. cabin with a bleed air manifold temperature of 330°F. This would provide approximately 3100 cubic feet per minute in the passenger cabin. If 250 passengers were onboard, this would correspond to 12.4 cu ft/min/passenger of fresh air in addition to 7.6 cu ft/min/passenger of recirculated air. Each of the remaining four switch positions on the pack flow selector reduces the scheduled maximum flow rate curve by about 10 percent per step. Therefore, the minimum flow position provides a flow rate of 1860 cu ft/min of fresh air to the cabin, the same fresh air rate per passenger for 150 passengers as the maximum flow rate supplied for 250 passengers.

(5) Both flow control valves will be closed automatically if the temperatures in the air cycle machine circuit exceed safe operating limits.

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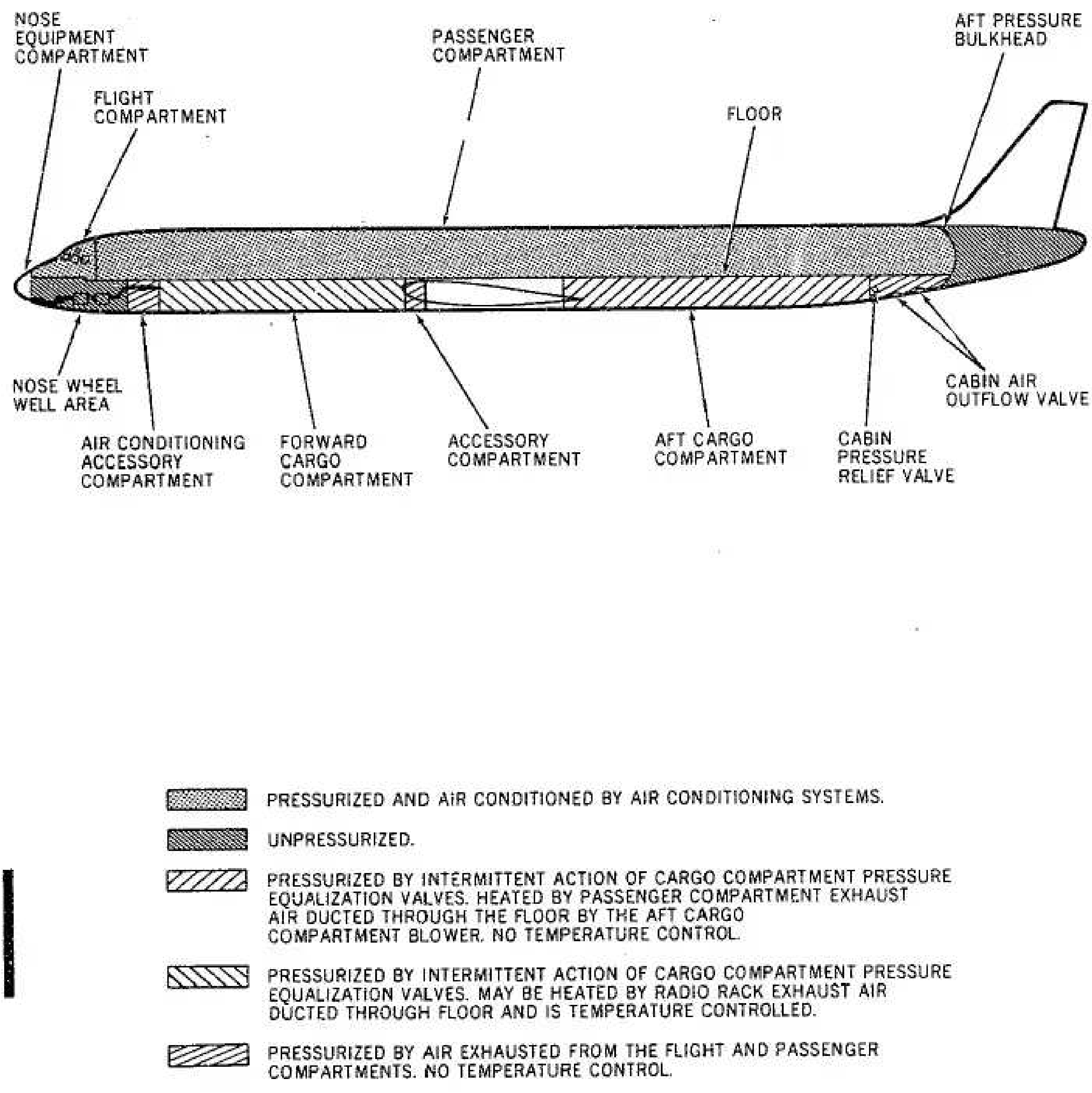

Pressurized Areas and Compartment Locations
Figure 1

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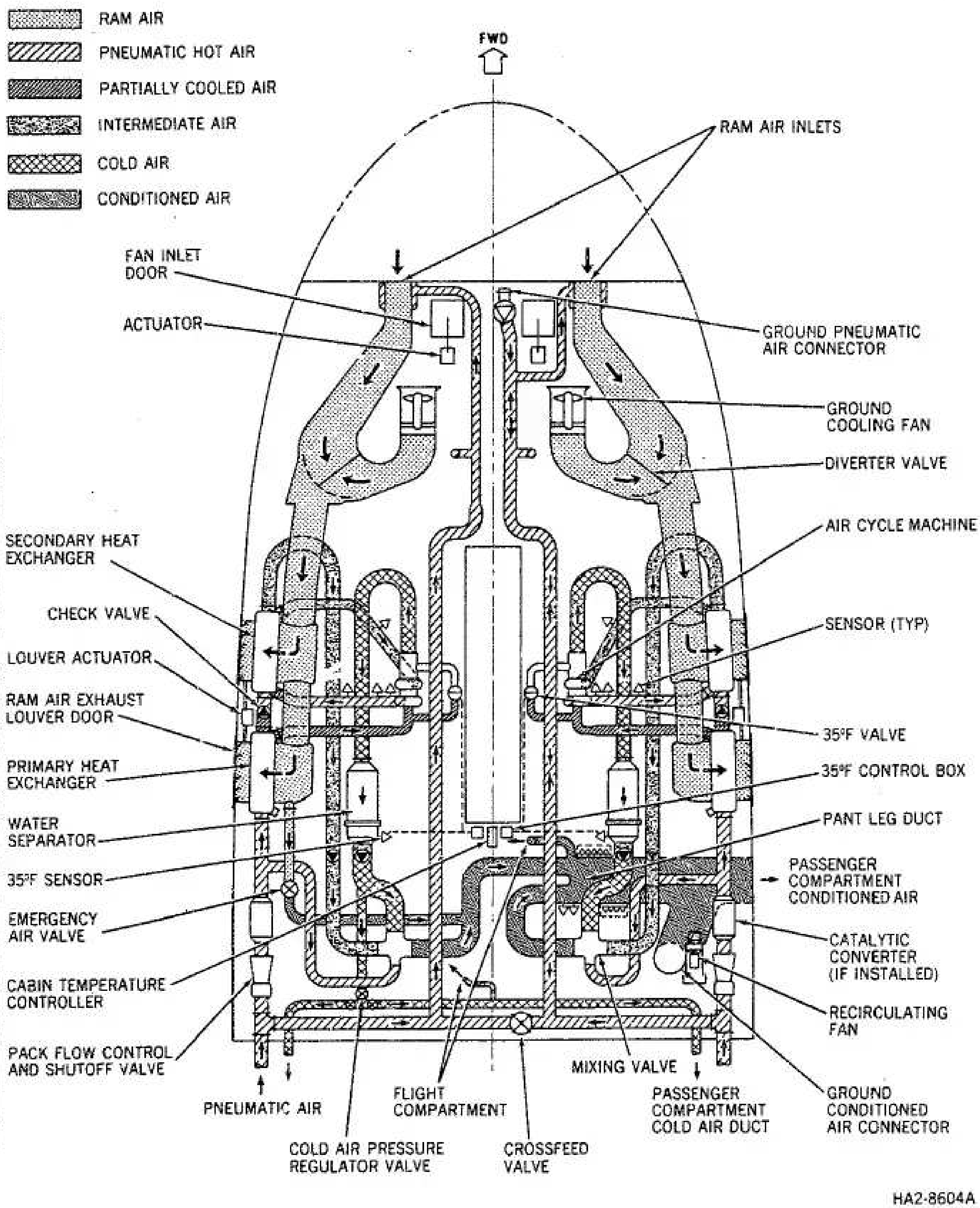

Air Conditioning System -- Schematic
Figure 2

TOC

E. Distribution

(1) Air conditioning distribution utilizes two entirely independent systems. The individual air distribution system routes only the cold air from the left air conditioning pack to individually regulated outlets in the flight and passenger compartments. The conditioned air distribution system routes the mixture of hot and cold air to the passenger and flight compartments.

(2) The individual air distribution system provides each crewmember and passenger a method for cooling his local area to a value different from that provided by the normal air conditioning automatic control. Air is received from the cold side of the left temperature control mixing valve and is ducted to each individual station. An adjustable nozzle at each station allows the individual a choice anywhere between no supplementary cold air and full system capacity cold air.

(3) The conditioned air distribution system directs the flow of ram air, hot air, warm air, cold air, conditioned air, and exhaust air. The left-hand system normally supplies the small amount of conditioned air used by the flight compartment. The remainder of the air from the left-hand system is combined with the right-hand system and delivered to the passenger compartment.

(4) The recirculating fan provides air recirculation from the air conditioning accessory compartment, through the recirculating fan wye duct, to the distribution system (see Figure 4). The recirculation fan will be ON normally but may be turned OFF when the airplane is in the "pull down" condition prior to passenger loading. The fan is inoperative during ground conditioned air service cart operation.

(5) In an emergency, ram air can be used for cabin ventilation. This air is supplied from the lefthand ram air ducting through a manually actuated shutoff valve. This valve is manually operated by a push-pull T-handle located in the flight compartment behind the observer's seat.

(6) Distribution system components consist of ducts, check valves, mufflers and exhaust vents, which are necessary to direct and control air distribution throughout the airplane. Each component functions individually to perform a particular requirement within the distribution system.

F. Pressurization Control

(1) The pressurization control system (see Figure 5) is designed to maintain the pressurized areas of the airplane at a pressure altitude of sea level while the airplane is at an altitude of sea level to 23,000 feet, and at a pressure altitude of 6700 feet while the airplane is at an altitude of 40,000 feet. These pressures impose a normal cabin-to-atmosphere pressure differential up to 8.77 psi on the airplane structure.

Pressurization is accomplished by discharging the output of the air conditioning system into the passenger and flight compartments and limiting the amount of exhaust air by opening and closing the cabin air outflow valve.

(2) Normal operation is automatic after selecting the desired cabin altitude and cabin rate-of-change on the cabin pressure controller. Manual control is possible by physical operation of the cabin air outflow valve manual control and indicating lever. The pressurization control system is monitored by the cabin altitude and differential pressure indicator and the cabin rate-of-climb indicator. A cabin low-pressure warning horn sounds intermittently when cabin pressure altitude exceeds approximately 10,000 feet. Two cabin pressure safety valves are set to relieve pressure if the pressure differential exceeds 8.82 psi.

G. Heating

(1) Flight compartment floor heating panels and fluted fiberglass panels are provided to warm the flight compartment floor, since the floor is exposed to ambient air temperature conditions. Conditioned air is passed through the fluted panels and is exhausted at floor level near the captain's and first officer's feet to help keep the immediate area warm. There are eight electrically operated flight compartment floor heating panels. Two panels are located in the navigator's area, four in the systems engineer's area, and one each in the captain's and first officer's areas.

(2) The floor heating panels are in operation whenever the airplane electrical load buses are energized and the cockpit heater circuit breakers are closed.

(3) The forward cargo compartment heating is secondary to the radio rack cooling. Additional heated air is supplied to the animal compartment from the pneumatic manifold through the animal compartment shutoff valve and is temperature controlled. The aft cargo compartment heating is secondary to the passenger compartment heating and is not temperature controlled.

H. Cooling

(1) The cooling systems for the airplane are; cooling packs, ram air system, radio rack control, and air-conditioning temperature control. The right and left air conditioning packs systems, which are independent of each other (see Figure 2), provide air-conditioning cooling in flight and give total cooling on the ground. Two distinct operational functions take place in each system. These are the mechanical function of the cooling cycle and the electrical function to stop, start, protect, and monitor system operation.

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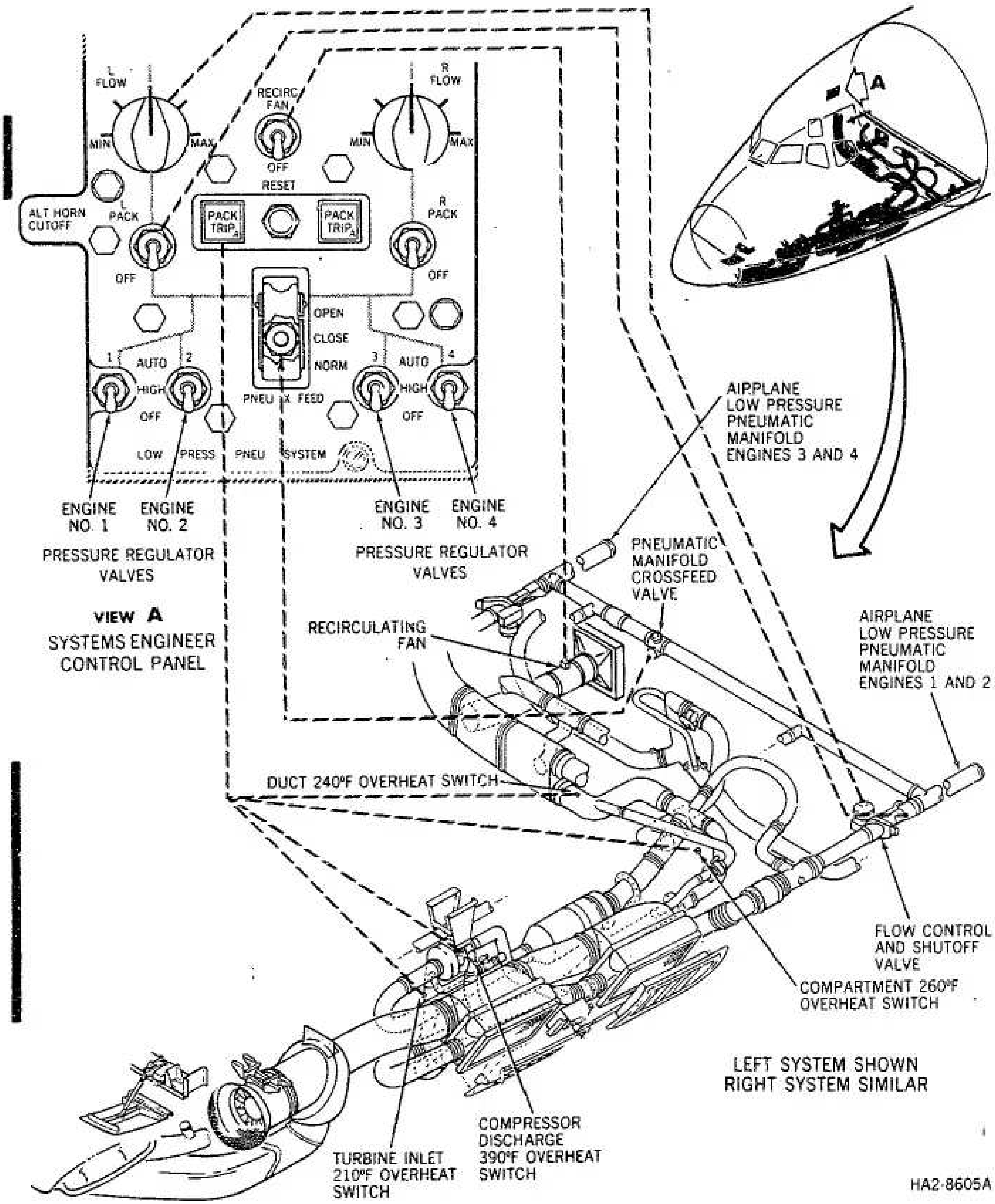

Air Conditioning Pressure Source--Operation
Figure 3

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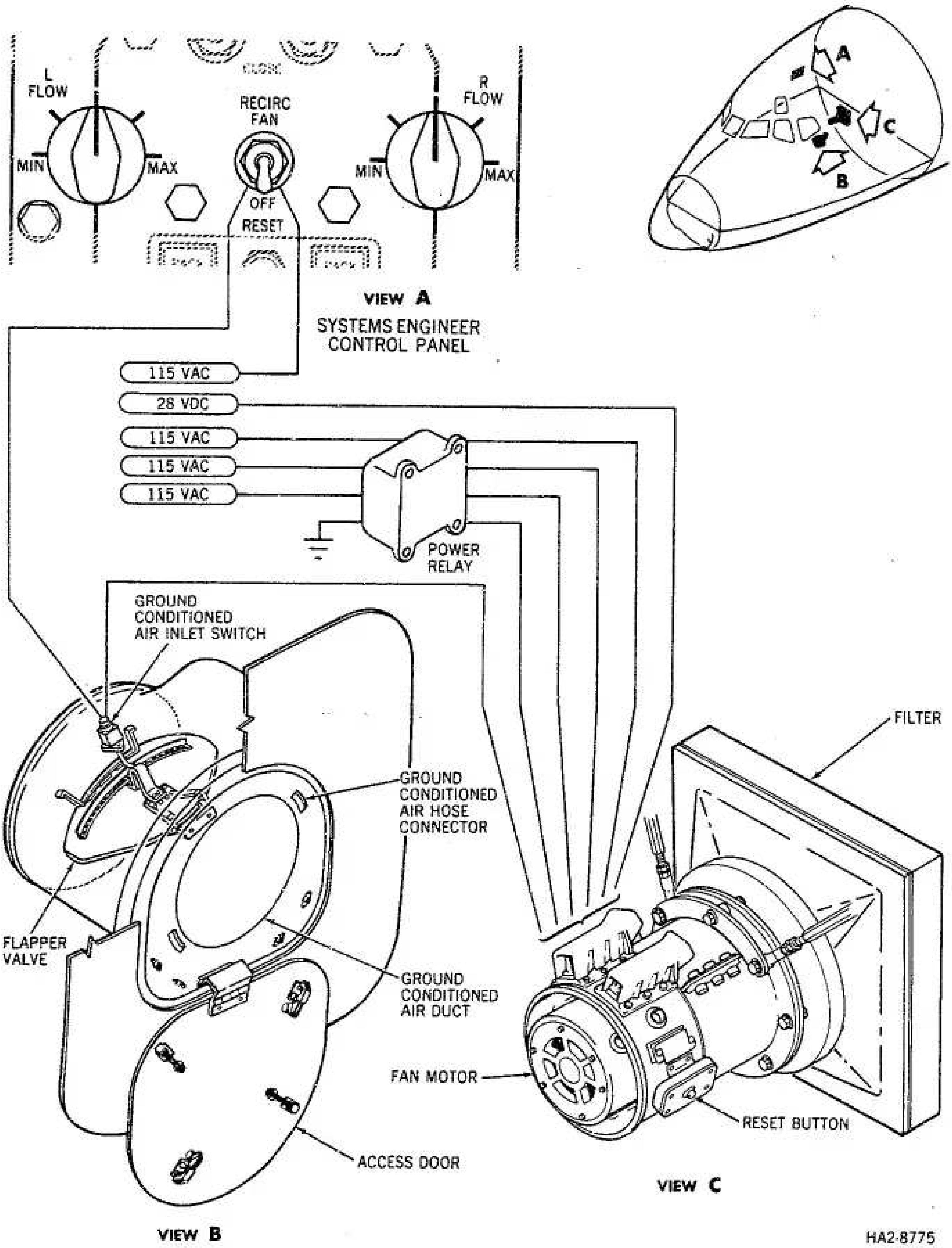
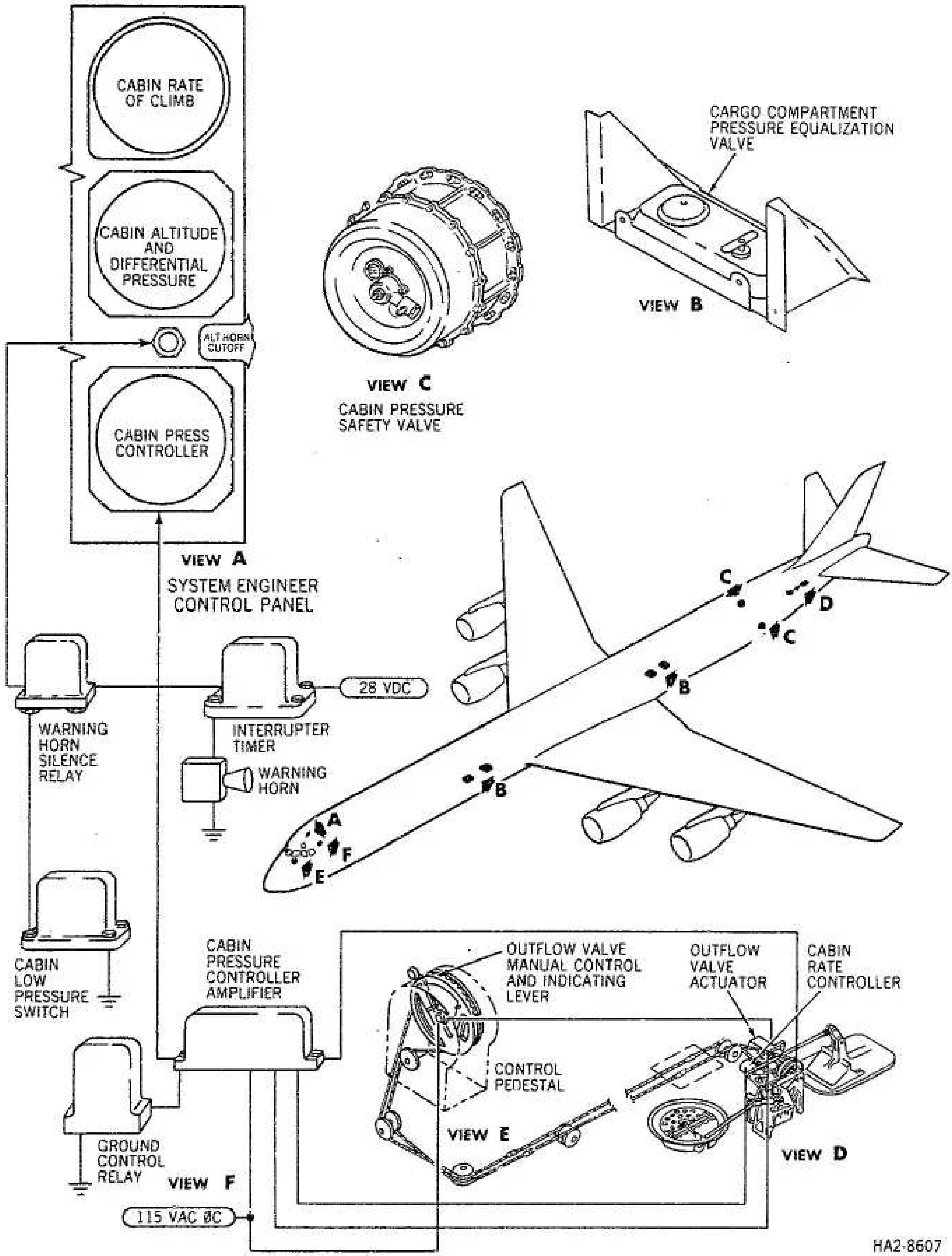


Recirculating Fan -- Operation
Figure 4

TOC



Pressurization Control -- Operation
Figure 5

(2) All cold air required is provided by two air conditioning packs. Passing bleed air through a primary heat exchanger, an air cycle machine, and a secondary heat exchanger cools the air sufficiently to provide a cooling medium with temperature low enough to handle any cooling situation required. The ram air system provides coolant air for the heat exchangers. A water separator removes excess moisture from the cooled air. Various thermal switches, thermostats, sensors, and valves are included with the pack to provide automatic protection for the packs, and warning against pack malfunction. Ram air cooling doors may be adjusted to increase or decrease airflow through the heat exchangers by switches on the systems engineer's control panel. A cooling door position indicator is also provided.

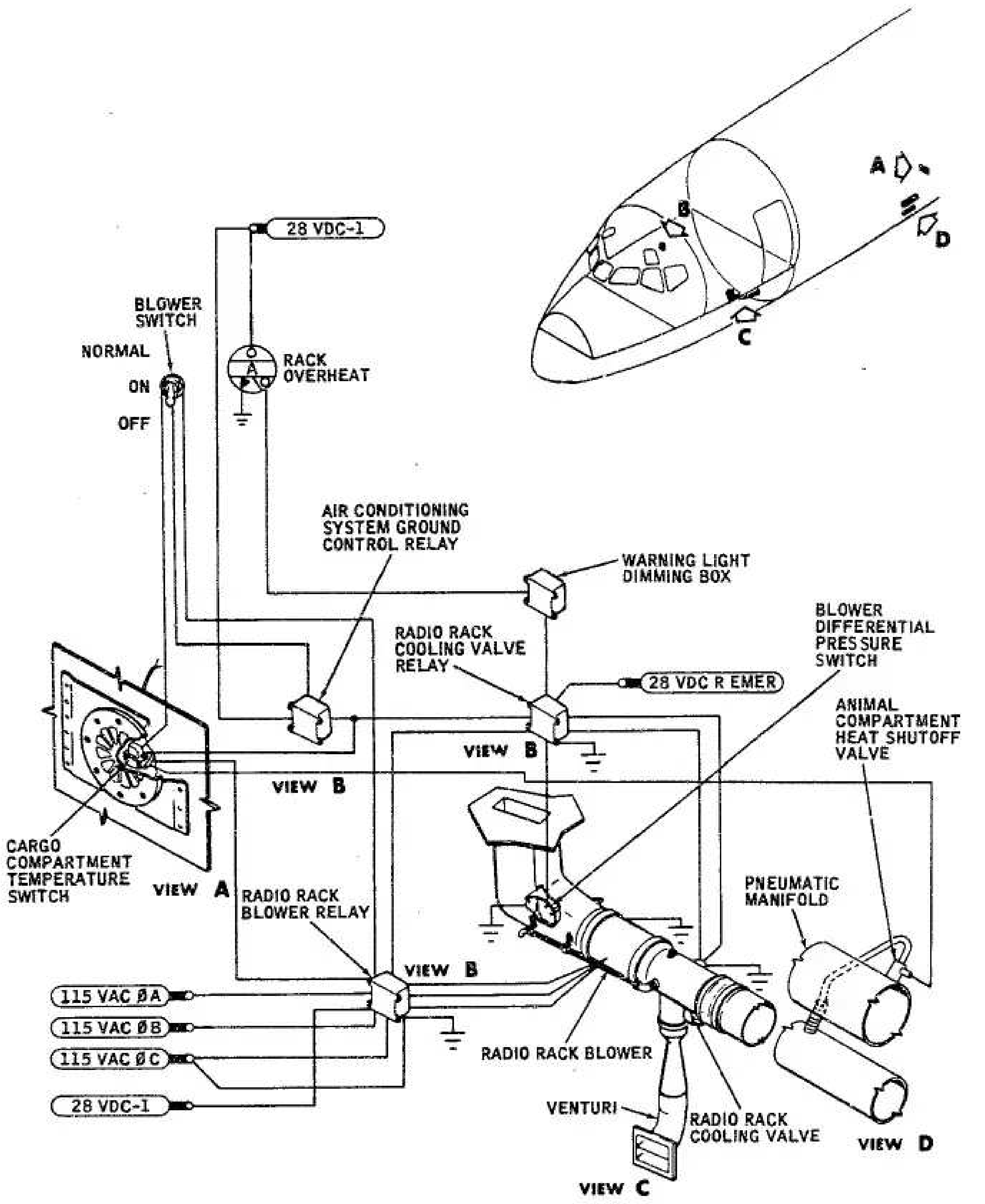
(3) The radio rack cooling system (see Figure 6) controls and directs the flow of flight compartment exhaust air to ventilate and cool the electrical and electronic equipment, and heat the forward lower cargo compartment augmented by the animal compartment heat shutoff valve. The venturi, ducts, and baffled air passages, together with the radio rack blower and radio rack cooling valve, are arranged so that the necessary amount of cooling air is available for the installed equipment. Flow of exhaust air from the flight compartment prevents concentrations of smoke in the flight compartment if equipment becomes overheated. The radio rack is shrouded and connected by ducts to the radio rack blower, which operates continuously when the airplane electrical buses are energized. After performing the radio rack cooling function, the air is normally circulated between the forward cargo compartment floor and airplane insulation.

(4) Ram airflow across the air-conditioning heat exchanger (see Figure 7) is controlled by opening and closing the exhaust louver with electrical actuators. The air-conditioning pack cooling door switch controls the direction and degree of rotation of the exhaust louver actuator. The position meters indicate the door position between close and open and are used to aid in rapidly establishing the proper cooling door position. The ram air cooling door control and position indicators are utilized in conjunction with the compressor outlet temperature meters to maintain proper air temperatures to the air cycle machine.

(5) Primary and secondary heat exchanger cooling airflow is provided by
R a ground cooling fan for all ground operations. In normal flight cooling airflow is supplied by ram air. A heat exchanger system is installed in each air conditioning system.

J. Temperature Control

(1) Temperature of the air entering the passenger and flight compartments (see Figure 8) is regulated by positioning the air mix valves. The mix valves provide three different flow patterns of air for air conditioning. The mix valve combines hot air from the pneumatic system,



NOTE: A = AMBER

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Radio Rack Cooling -- Operation
Figure 6

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cold air which has gone through the heat exchangers and air cycle machine, and air cycle machine bypass air only through the primary and secondary heat exchangers. The amount of airflow through the mix valves is regulated by the temperature control system. There is one mix valve for each air conditioning pack (see Figure 8). Two sets of controls on the systems engineer's control panel provide automatic or manual control and system monitoring for each pack. The flight compartment controls apply to the left pack and the passenger compartment controls the right pack. Each control system consists of a temperature regulator, temperature sensor, overheat control and warning light, and mix valve position indicator.

2. To Operate System

A. General

(1) Power may be supplied to the air conditioning system from an external source or from an operating engine. Sufficient pneumatic and electrical power is available to operate the air conditioning systems when the engines are operating at idle. Ground power required to operate the air conditioning systems at maximum capacity is given in Figure 9.

(2) The amount of cooling provided by the air conditioning systems is dependent upon air source flow rate pressure and temperature, and upon ambient temperature and humidity. With 224 pounds per minute of air supplied from a ground cart at 35 psig and 450°F, with both air conditioning systems operating, but without the recirculating fan operating, the airplane can be cooled on a "hot" day from an initial cabin temperature of 110°F, to 75°F in approximately 25 minutes. A "hot" day is specified as an ambient temperature of 103°F and a humidity of 118 grains of water per pound of dry air.

(3) Each air conditioning system is controlled and monitored from the systems engineer control panel in the flight compartment. Circuit breakers necessary for operation of the air conditioning system packs, valves, shutdown circuits, and warning indicators are listed in Figure 10. The controls and indicator functions are listed in Figures 11 and 12.

B. Ground Pneumatic Supply Requirements

(1) The temperature of the air supplied to the airplane pneumatic system directly affects the efficiency and service life of certain airplane system components. Ice formation in the discharge air from the air cycle machine turbine or compressor affects performance and control, and causes erosion in the turbine. Maintaining a minimum temperature of 160°F (71°C), at a pressure of 30 to 40 psig, at the fuselage nose ground pneumatic connector prevents ice formation.

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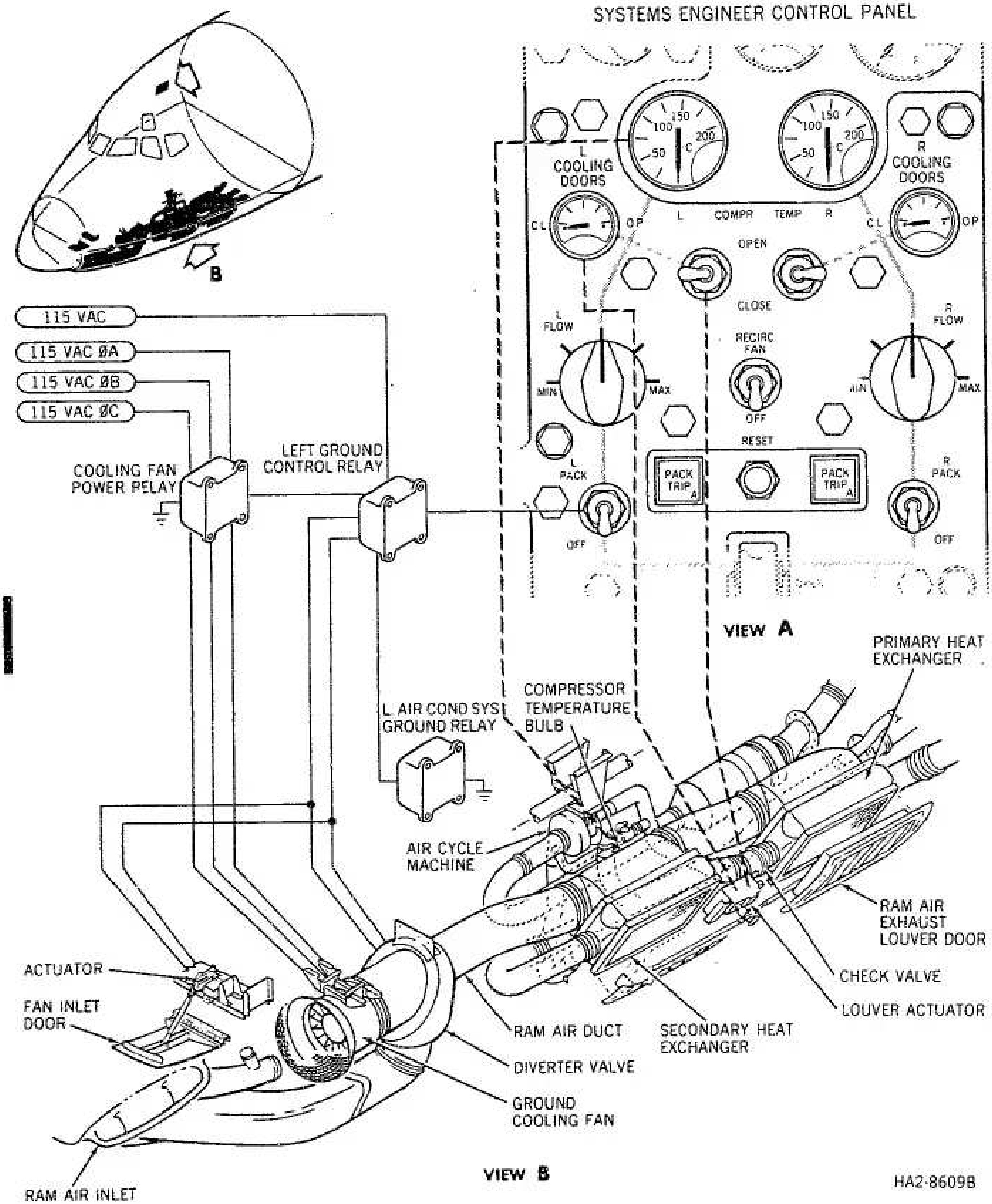

Ram Air Control -- Operation
Figure 7

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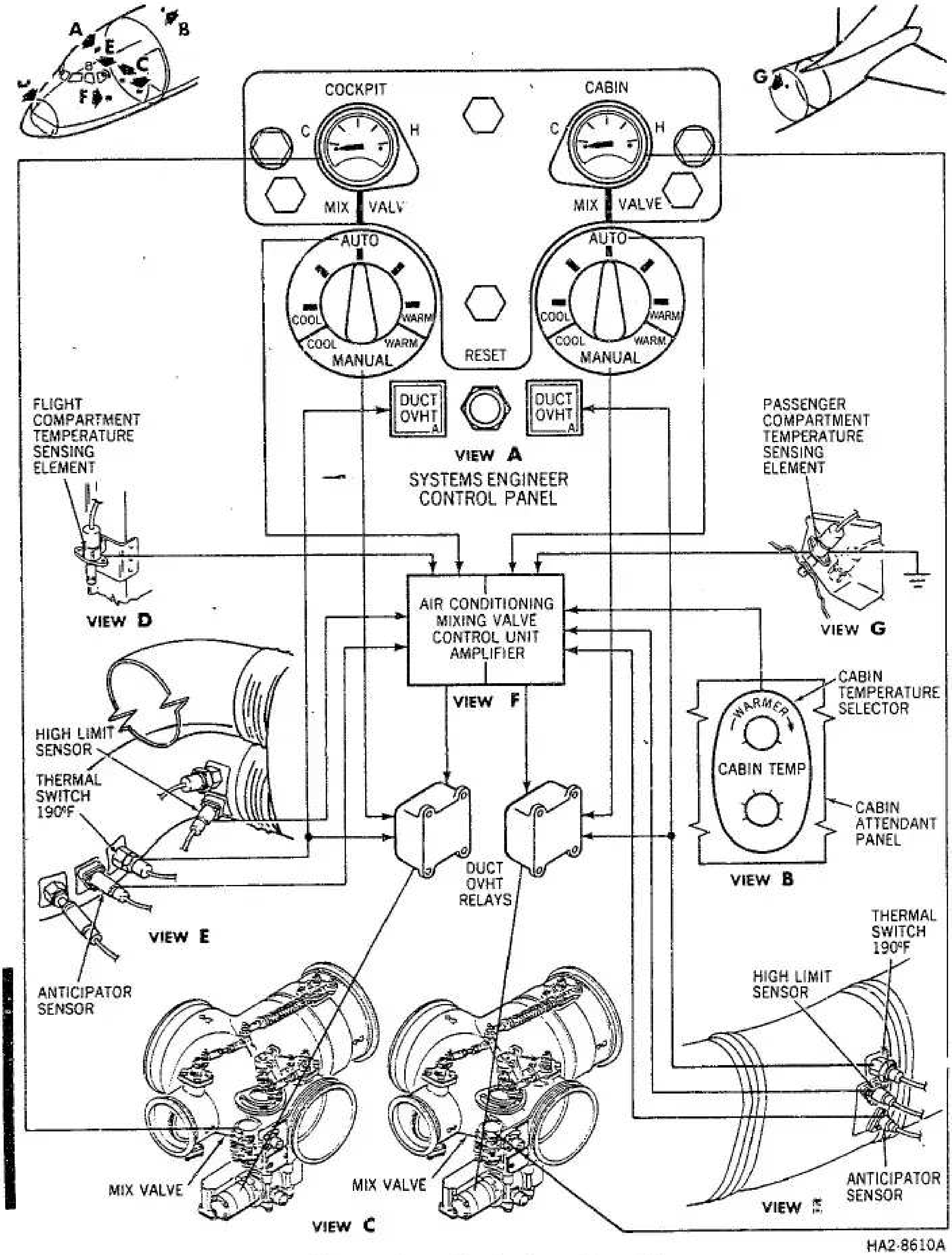

Temperature Control -- Operation
Figure 8

TOC

(2) Oil entrained in the supply air picks up dirt; and, when in contact with hot machine parts, forms gum and hard deposits which affect friction and cause pressure drops in control orifices. At 160°F (71°C) oil is still in liquid form, but at 450°F (232°C) most of the oil remains vaporized throughout the cycle. Because even a 10-micron, entrapment-type filter cannot be depended upon to filter out all oil, centrifugal compressors, and reciprocating compressors with carbon piston rings, are preferred as ground pneumatic sources. All ground sources, except centrifugal compressors, must incorporate a 10-micron filter, and all ducting downstream of the filter must be maintained scrupulously free of rust and dirt particles. To reduce airflow requirements and to maintain residual oil in the entrained condition, the temperature of the supply air as delivered to the ground connector should be maintained at the highest value the airplane system involved can accept. Ground supply air can be applied to the ground connector at a maximum temperature of 460°F (237°C) except when the deicing system is operating (see Chapter 30).

Operation	Ac Electrical Power	Pneumatic Power
One air-conditioning system	90-120 amperes at 115-volt, 3-phase, 400-hertz, for 10 second start and 33 (±5) amperes for normal operation.	Flow - 65-120 lb/min Pressure - 30-38 psig Temperature - 330° to 450°F (165.6° to 237.7°C)
Both air-conditioning systems	66 amperes at 115-volt, 3-phase, 400-hertz for normal operation.	Flow - 130-240 lb/min Pressure - 30-38 psig Temperature 330° to 450°F (165.6° to 237.7°C)

Air-Conditioning System Power Requirements
Figure 9

NOTE: When one air-conditioning system is first turned on, the initial load is approximately 105 amperes for ten seconds. Normal operating load for one system is approximately 33 amperes. When the other air-conditioning system is turned on the total initial load is approximately 130 amperes for ten seconds. Normal operating load with both systems operating is approximately 66 amperes.

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Circuit Breaker	Panel Section
Ground control relay	Miscellaneous (ac bus)
Pack and supply air temperature indicator	Heat, vent, and ice protection (dc bus)
Recirculating fan protection	Heat, vent, and ice protection (dc bus)
Left water separator 35°F Control	Heat, vent, and ice protection (ac bus)
Recirculating fan control	Heat, vent, and ice protection (ac bus)
Right water separator 35°F Control	Heat, vent, and ice protection (ac bus)
Cabin temperature indicator	Heat, vent, and ice protection (dc bus)
Recirculating fan protection	Heat, vent, and ice protection (dc bus)
Aft cargo compartment blower phase A	Aft cabin electrical panel
Aft cargo compartment blower phase B	Aft cabin electrical panel
Aft cargo compartment blower phase C	Aft cabin electrical panel
Cabin pressure control	Heat, vent, and ice protection (ac bus)
Takeoff and cabin low pressure warning	Miscellaneous dc bus 1
Cockpit auto temperature control	Heat, vent, and ice protection (ac bus)
Cabin auto temperature control	Heat, vent, and ice protection (ac bus)
Pack control left	Heat, vent, and ice protection (dc bus)
Pack control right	Heat, vent, and ice protection (dc bus)
Duct overheat left	Heat, vent, and ice protection (dc bus)

Air Conditioning System Circuit Breakers
Figure 10 (Sheet 1)

	Circuit Breaker	Panel Section
	Duct overheat right	Heat, vent, and ice protection (dc bus)
R	Pack trip right	Battery bus direct (dc bus)
R	Pack trip left	Battery bus direct (dc bus)
	Cockpit manual temperature control	Heat, vent, and ice protection (ac bus)
	Cabin manual temperature control	Heat, vent, and ice protection (ac bus)
	Pack compressor temperature indicator	Heat, vent, and ice protection (dc bus)
	Pack valve position indicator	Heat, vent, and ice protection (dc bus)
	Radio rack blower phase A	Miscellaneous (ac bus)
	Radio rack blower phase B	Miscellaneous (ac bus)
	Radio rack blower phase C	Miscellaneous (ac bus)
	Animal Compartment Heat Shutoff Valve	Miscellaneous (dc bus 1)
	Radio rack blower warning	Miscellaneous (dc bus 1)
	Radio rack cooling	Right dc emergency bus
	Pack vane door control left	Heat, vent, and ice protection (ac bus)
	Pack vane door control right	Heat, vent, and ice protection (ac bus)
	Pack cooling fan control left	Heat, vent, and ice protection (ac bus)
	Pack cooling fan control right	Heat, vent, and ice protection (ac bus)
	Systems engineer's panel red light	Lighting, (ac bus)
	Cabin pressure door control	Heat, vent, and ice protection (ac bus)
	Manifold air temperature indicator	Heat, vent, and ice protection (dc bus)

Air Conditioning System Circuit Breakers
Figure 10 (Sheet 2)

Control	Function
Low pressure pneumatic shutoff switches 1, 2, 3, and 4	
Auto position	Bleed air system on that engine maintains 38 psig nominal, automatically switching from 5th to 9th stages as required
High position	The automatic system is overridden and 9th stage supplies air whenever 5th stage pressure is below the high stage regulating setting (approximately 45 psig).
Off position	All air from that engine is terminated
Pneumatic crossfeed valve control switch	
Open position	The valve is maintained in an open condition so that the bleed air manifold is continuous from wing to wing
Close position	The valve is maintained in a closed condition so that the bleed air manifold is divided in half at the centerline of the airplane
Norm position	The valve is essentially closed in flight and open on the ground and is repositioned between these conditions automatically
Flow control/shutoff switches L PACK and R PACK	
On position	The flow control valve for that particular pack is activated to provide controlled air-flow to the air conditioning system
Off position	The flow control valve closes and no pack flow exists

Air Conditioning System Controls
Figure 11 (Sheet 1)

Control	Function
Pack trip reset push button switch	When the left or right pack trip light comes on, the flow control valve will close. The flow control valve can be reopened, and the pack trip light goes off only if the condition causing the trip has returned to normal conditions, and the reset push button has been activated
Pack flow selector five position rotary switches left and right	
Maximum position	The flow control for the particular pack controls the pack flow to the maximum ventilation rate schedule automatically
Intermediate positions	Rotating the switch counterclockwise toward MIN reduces the flow schedule approximately 10 percent per step
Minimum position	Pack flow schedule reduced to approximately 60 percent of the maximum schedule
Recirculating fan switch	
Recirc fan position	Normal position and turns the recirculating fan on
Off position	The recirculating fan may be turned off on the ground
Left and right cooling doors control switches	
Open position	Momentary position to move the heat exchanger ram air cooling exit louvers toward the open position
Center position	Spring loaded to center stops operation of cooling doors
Close position	Momentary position to move the heat exchanger ram air cooling exit louvers toward the close position

Air Conditioning System Controls
Figure 11 (Sheet 2)

TOC

Control	Function
Temperature indicator selector switch	
Left pack position	Monitors left pack output air temperature
Right pack position	Monitors right pack output air temperature
Cabin supply position	Monitors cabin supply air temperature
Duct overheat reset push button switch	When the flight or passenger compartment duct overheat light comes on, the respective temperature control valve is driven in a direction to produce maximum cooling. Once the condition causing the overheat has been alleviated and the reset button has been activated, the light will go off and the system will return to normal
Temperature selectors flight and passenger compartment	
Automatic temperature control selection	Temperature controls are energized and the selected temperatures are controlled automatically
Cool position	Corresponds to a flight or passenger compartment temperature of approximately 65°F
Warm position	Corresponds to a flight or passenger compartment temperature of approximately 85°F
Manual position	The automatic temperature control is de-energized and the temperature control valves at the output of each pack are controlled directly by manipulation of the manual switch

Air Conditioning System Controls
Figure 11 (Sheet 3)

Control	Function
Cool position	Momentary position to move the temperature control valve toward cool
Down position	Spring loaded to the 6 o'clock position and the temperature control valve remains in the last position
Warm position	Momentary position to move the temperature control valve toward warm
Cabin pressure controller	
Altitude selector knob (normal or retracted position)	Set desired cabin altitude in feet as indicated in window
Altitude selector knob (pulled out position)	Set airport barometric pressure in inches of mercury or millibars
Rate control knob	Set desired cabin rate of climb in feet per minute
Cabin air outflow valve manual control and indi-lever	With knob in normal position, lever indicates position of cabin air outflow valve in automatic mode. With kn.b on lever lifted and turned 90 degrees, lever manually controls position of cabin air outflow valve
Altitude horn cutoff switch	Silence takeoff and cabin low-pressure warning horn
Blower switch	
Normal (guarded) position	Energize blower circuits and radio rack cooling valve close circuits when airplane is on ground; energize blower circuits, radio rack cooling valve, and animal compartment heat shut-off valve circuits in flight when temperature of forward cargo compartment is between 60° and 75°F
Off position	Deenergize blower and energize radio rack cooling valve open circuits
On position	Energize blower and radio rack cooling valve close circuits

Air Conditioning System Controls
Figure 11 (Sheet 4)

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Indicator	Function
Pack trip lights left and right	The left or right light is activated and the flow control valve is closed automatically due to the flight compartment (left pack) or passenger compartment (right pack) inlet ducts have exceeded 240°F, or, the turbine inlet of the air cycle machine has exceeded 210°F, or, the compressor outlet of the air cycle machine has exceeded 390°F, or temperature in air conditioning tunnel exceeds 260°F
Left and right cooling doors indicators	Indicate the louver door position between closed and open and used in rapidly establishing the proper cooling door position
Compressor temperature indicator left and right	Indicates air cycle machine compressor outlet temperature
Temperature indicator	Indicates temperatures as selected by the temperature indicator selector switch
Cabin temperature indicator	Indicates passenger compartment temperature
Cockpit and cabin mix valve position indicators	Indicates the position of the respective mixing valve between cold and hot and is especially useful if the temperature selector is in the manual mode
Cabin altitude and differential pressure indicator	Indicate cabin altitude in feet and cabin-to-atmosphere differential pressure
Cabin rate-of-climb indicator	Indicate rate-of-climb of cabin altitude in feet per minute.
Takeoff and cabin low-pressure warning horn	Sound when airplane cabin altitude is approximately 9500 to 10,000 feet
Radio rack overheat indicator	Indicator lights when less than 2 1/2 psi is sensed across radio rack blower duct and blower circuit is energized

Air Conditioning System Indicators
Figure 12

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C. Pressure and Airflow Requirements

(1) The airplane pneumatic manifold can be pressurized from either the compressors of the airplane engines, the APU, or a ground pneumatic source. When the manifold is pressurized from the engines, the engine power and the airplane pneumatic system automatically control manifold temperature and pressure (see Chapter 36). When the manifold is pressurized from a ground pneumatic source that is applied to the fuselage nose ground pneumatic connector, the manifold pressure should be kept above 13 psig as indicated by the flight compartment manifold pressure indicator.

(2) Normal manifold leakage permits the decay of airplane manifold pressure after the ground pneumatic source is shut off. Rapid relief of manifold pressure can be effected by operating any air-consuming airplane system, except the air conditioning packs, provided the ground pneumatic source is first shut off.

D. Air Conditioning System Preparation for Starting

NOTE: Circuit breakers that control operation of valves, overheat shutdown circuits, and warning circuits of the air conditioning system are listed in Figure 10.

(1) Position switches and controls as follows:

Control	Position
Pack switches	Off
Flow selectors	Up
Low-pressure pneumatic manifold crossfeed valve switch	Norm
Recirculating fan switch	Off
Low press pneu system switches	Auto
Cooling doors indicators	Open
Air conditioning temperature selectors	Automatic mode (center dot)
Temperature indicator selector	Cabin supply
Cabin air outflow valve manual control and indicating lever	Automatic mode (unlocked position)

NOTE: The cabin pressure control system is in the automatic mode when the cabin air outflow valve manual control and indicating lever knob is parallel with the control quadrant. The cabin pressure control system is in the manual mode when the manual control and indicating lever knob is extended and turned 90 degrees, allowing the lever to be locked in any position over the operating range.

(2) Pressurize airplane pneumatic manifold (see Chapter 36).

(3) Check for minimum of 13 psig on pneumatic manifold air pressure indicator.

E. Start Air Conditioning System

(1) Perform air conditioning start preparation.

(2) Place PACK switch in the up position. Observe pack start by an increasing COMPR TEMP indication.

(3) Place cabin attendants temperature selector on cabin attendants electrical panel in central position.

(4) Verify temperatures using the temperature indicator selector switch.

(5) Verify cabin temperature indication.

GENERAL - MAINTENANCE PRACTICES

1. General

A. Precautions

(1) Use care in handling thin wall air-conditioning tubing. Do not install duct sections that are obviously distorted or damaged.

(2) During removal and installation procedures, immediately close off duct or component openings. Do not remove protective end closures from ducting until just before installation.

(3) Ensure that interior of ducts and components are free from dirt or contamination. If dirt or contamination is suspected, blow out with dry air before installation.

(4) Never force or bend tubing into place. Reject duct assemblies that do not fit. Obtain proper alignment by assembling ducts and components loosely and by adjusting until satisfactory clearances and alignment are determined.

(5) Flange faces of pneumatic duct assemblies and components should be kept free from dirt, grease, nicks, scratches, or dents so that effective joint can be made when the clamp is installed. Do not use wire brush to clean flange surfaces.

(6) Use no lubricants other than water.

2 Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Solvent	No. 14	Douglas Aircraft Co., Inc.	Prepare metal surfaces for bonding
B	Solvent	No. 15	Douglas Aircraft Co., Inc.	Prepare metal surfaces for bonding
C	Airtron sheet	3-4365-272B	Arrow Head Products	Form air-conditioning duct joints
D	Toluene	Federal Spec. TT-T-584 (2)		Clean rubber sheet before bonding

Item	Name	Number	Manufacturer	Use
E	Sandpaper	No. 180 grit	Minnesota Mining & Manufacturing Co.	Roughen rubber sheet prior to bonding
F	Adhesive	EC-870	Minnesota Mining & Manufacturing Co.	Bond rubber to rubber
G	Glass fiber tape (double faced)	7100G	Mystic Tape Products	Wrap cold air ducting before installing connector and form cold air duct joints
H	Silicon adhesive	Silastic 731-RTV	Dow-Corning Corp.	Secure tape end during cold air duct installation
J	Trichloroethylene	MIL-T-7003		Clean ducts prior to installation
K	Sealant	PR-1422	Products Research Co.	Low temperature sealing
L	Sealant	RTV-1016	General Electric Silicone Products	High temperature sealing
M	Catalyst	RTV-992	General Electric Silicone Products	Use with RTV-1016
N	Sealant primer	A-4094	Dow-Corning Corp.	Primer prior to sealing
O	Sealant	EC-1608	Minnesota Mining & Manufacturing Co.	Low adhesion sealant for removable service items
P	Fire-resistant adhesive tape	68W (white)	Permacel Tape Corp.	Seal between lining panels

3. Removal/Installation

NOTE: The following procedures describe typical installation of ducting used in the air conditioning system.

A. Install Main Conditioned Air Ducts

NOTE: General precautions (see paragraph 1) are to be noted during duct installation.

(1) Cut airtron sheet to size as shown in Figure 201, view A.

(2) Roughen faying surfaces of airtron sheet overlap area with sandpaper.

(3) Clean faying surfaces of airtron sheet by wiping with clean cotton cloth, dampened with toluene.

(4) Apply uniform brush coat of adhesive (EC-870) to faying surfaces of airtron sheet overlap area. Allow adhesive to dry until tacky.

NOTE: Proper tackiness can be determined by lightly touching the adhesive with the knuckles. If the adhesive sticks, grabs, or tends to adhere to knuckles without coming off, proper tackiness has been reached.

(5) Press prepared surfaces of airtron sheet firmly together (forming a duct connector).

(6) Install on duct as shown in Figure 201, view A.

NOTE: The air conditioning system should not be turned on for approximately 8 hours.

(7) Install and tighten clamps fingertight, plus 1/2 turn.

B. Install Conditioned Air Duct

NOTE: The general precautions (see paragraph 1) are to be noted during duct installation.

(1) Ensure that sufficient clearance exists between adjoining duct ends.

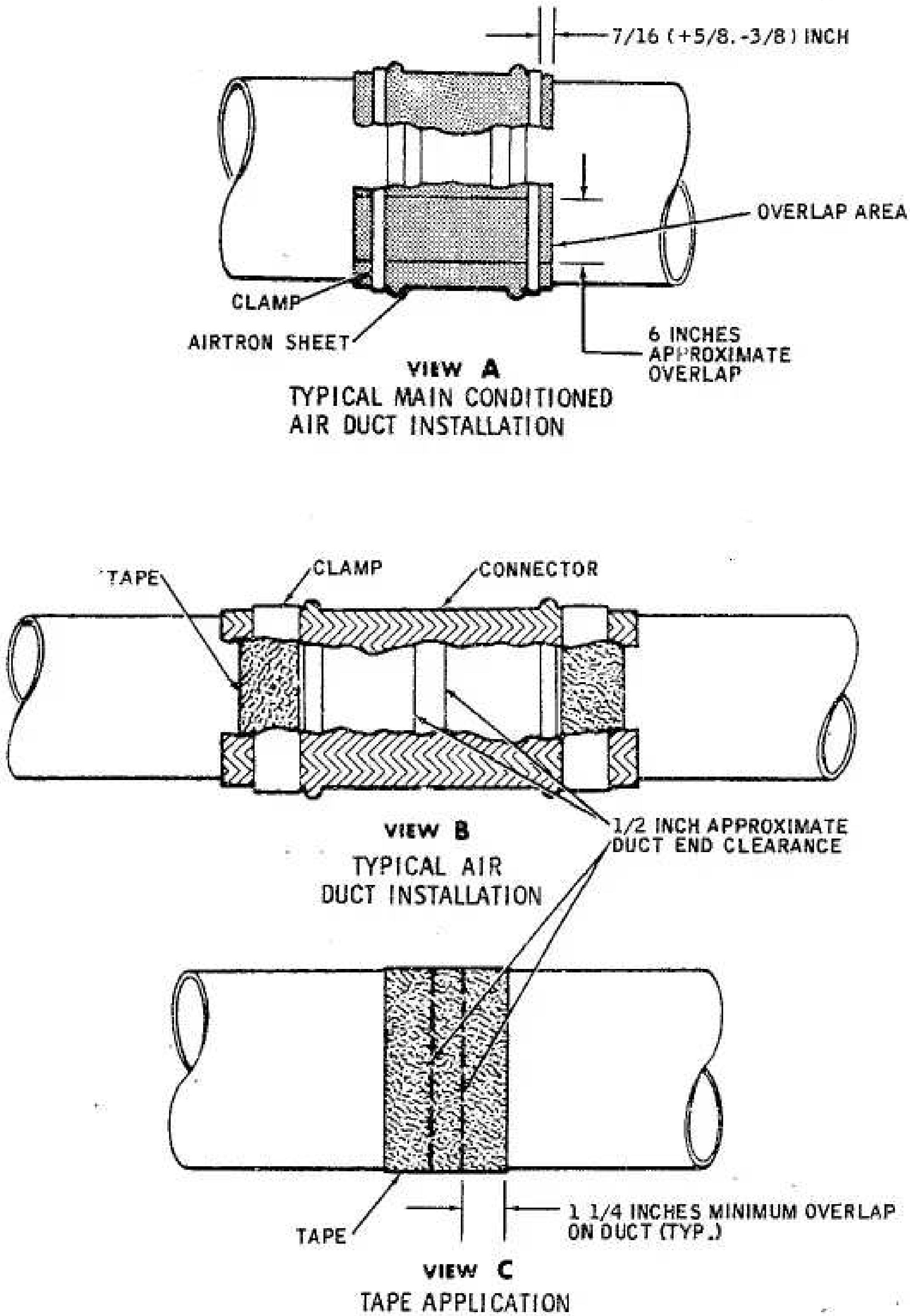
(2) Ensure that duct mismatch and deflection are within reasonable limits.

(3) Wipe duct surfaces clean with dry cotton cloth.

(4) Install dry connector.

NOTE: If difficulty is experienced in slipping connector onto ducts, a little water may be applied to the outside of the duct to facilitate installation.

(5) Install and tighten clamps fingertight, plus 1/2 turn.



HA2-8611A

Typical Conditioned and Cold Air Duct Installation
Figure 201

C. Install Cold Air Ducts

NOTE: The general precautions (see paragraph 1) are to be noted during duct installation.

(1) Ensure that sufficient clearance exists between adjoining duct ends.

(2) Ensure that duct mismatc and deflection are within reasonable limits.

(3) Wipe surfaces of ducts with cloths dampened with trichloroethylene.

(4) When connector and clamps are used to join ducting, proceed as follows:

(a) Tightly wrap two layers of glass fiber tape (7100G) immediately behind bead of ducts.

(b) Install connector and clamps. Tighten clamps fingertight plus 1/2 turn.

NOTE: Position connectors and clamps so that tape acts as a gasket between the duct and connector at the clamping point.

(5) When glass fiber tape (7100G) is used to join ducting, proceed as follows:

(a) Tightly wrap two layers, plus 1/2-inch, of glass fiber tape to ducts as shown in Figure 201, View C.

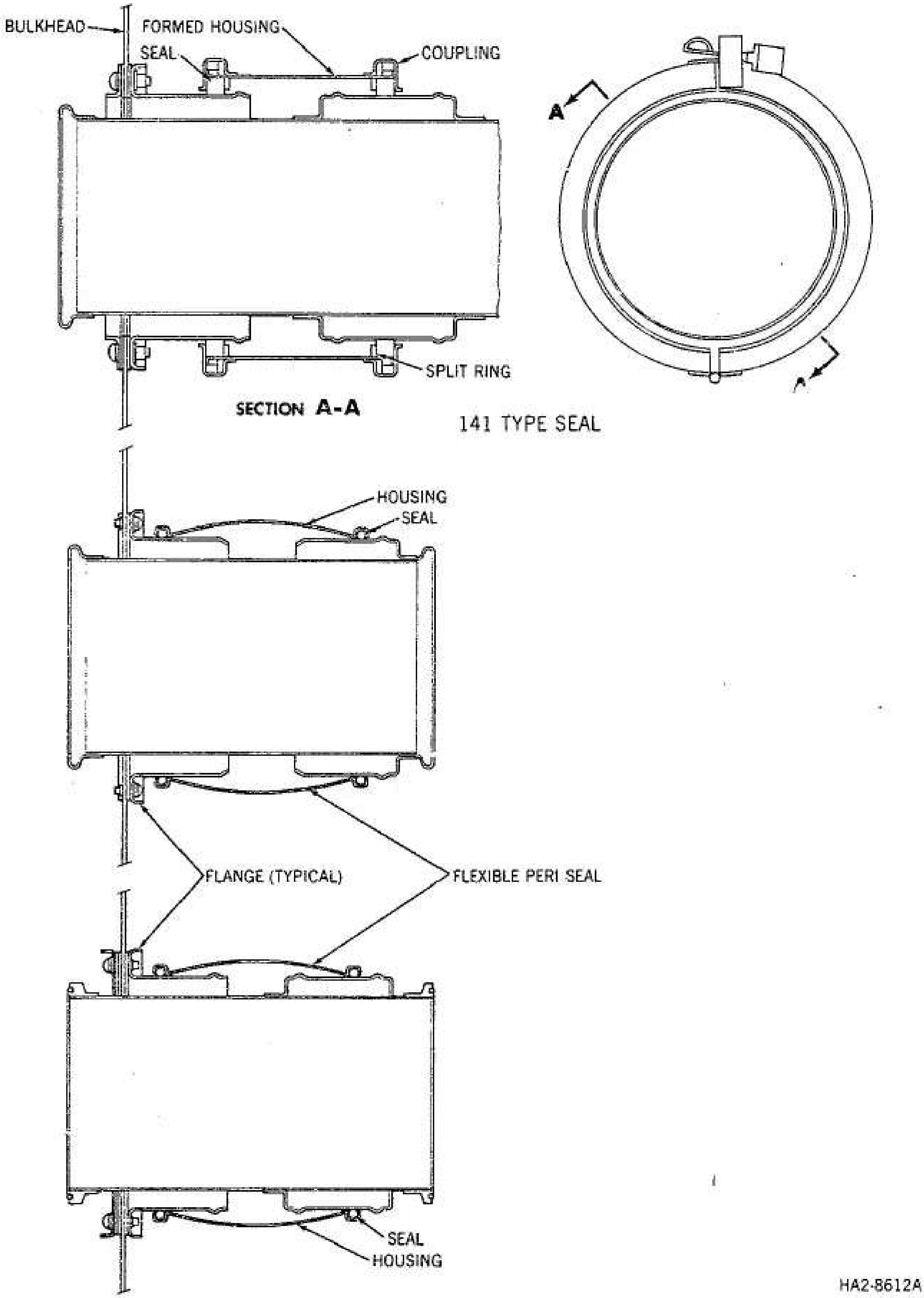
NOTE: Keep wrinkles to a minimum. Wrinkles in the outer layer are not to coincide with wrinkles in the inner layer.

(b) Apply approximately 1/4-inch bead of silicon adhesive (Silastic 731-RTV) to secure tape end.

D. Install Bulkhead Duct Connector

NOTE: The general precautions (see paragraph 1) are to be noted during duct installation. Special precautions are to be taken to prevent denting, scratching, or deforming cover.

(1) Install new seals in groove at duct connector ends. Do not excessively stretch or deform seal. Ensure that seal is not twisted and fits snugly in grooves (see Figure 202).



Bulkhead Duct Connectors
Figure 202

(2) Slide duct connector over one duct before aligning duct. Install ducts so that flanges are parallel to each other within 5 degrees and gap between flanges is 1/2 (±7/16) inch. No offset misalignment or side load on duct or cover is permitted.

(3) Install end connectors if applicable.

E. Install Pneumatic Supply Du ts

CAUTION: WHEN FLANGE FACE IS EXPOSED, IMMEDIATELY INSTALL PROTECTIVE CAP.

NOTE: Flange faces should be kept free from dirt, grease, nicks, scratches, or dents so that an effective joint can be made when clamp is installed. To preserve the joint self-sealing characteristics, it is necessary to maintain the conical shape of each flange face and the flatness of the inner flange edge. The general precautions (see paragraph 1) are to be noted during duct installation.

(1) Ensure that mating flanges are free from dirt and grease.

(2) Back off locknut (see Figure 203) toward end of T-bolt.

(3) Slip expanded clamp over mating surfaces.

(4) Position T-bolt and tighten locknut to torque of 45 (±5) inch-pounds for clamp sizes up to but not including 4-inch diameter (10-.2 bolt) or 60 (±5) inch-pounds for clamp sizes 4-inch diameter or larger (1/4-28 bolt).

4. Air-Conditioning Sealing Information

A. To ensure operating efficiency of the air conditioning system, components in the system must be properly sealed during installation to prevent leakage while the system is in operation. Instructions in this paragraph cover the general use of sealants used in the air conditioning system. Instruction on the use and handling of sealants are contained in Chapter 13. Specific instructions for sealing system components are found in the Maintenance Practices sections covering those components that require sealing.

NOTE: Instruction in this paragraph apply only to the sealing of air-conditioning components. For information on pressurization sealing of structure, see Structural Repair Manual, Chapter 51.

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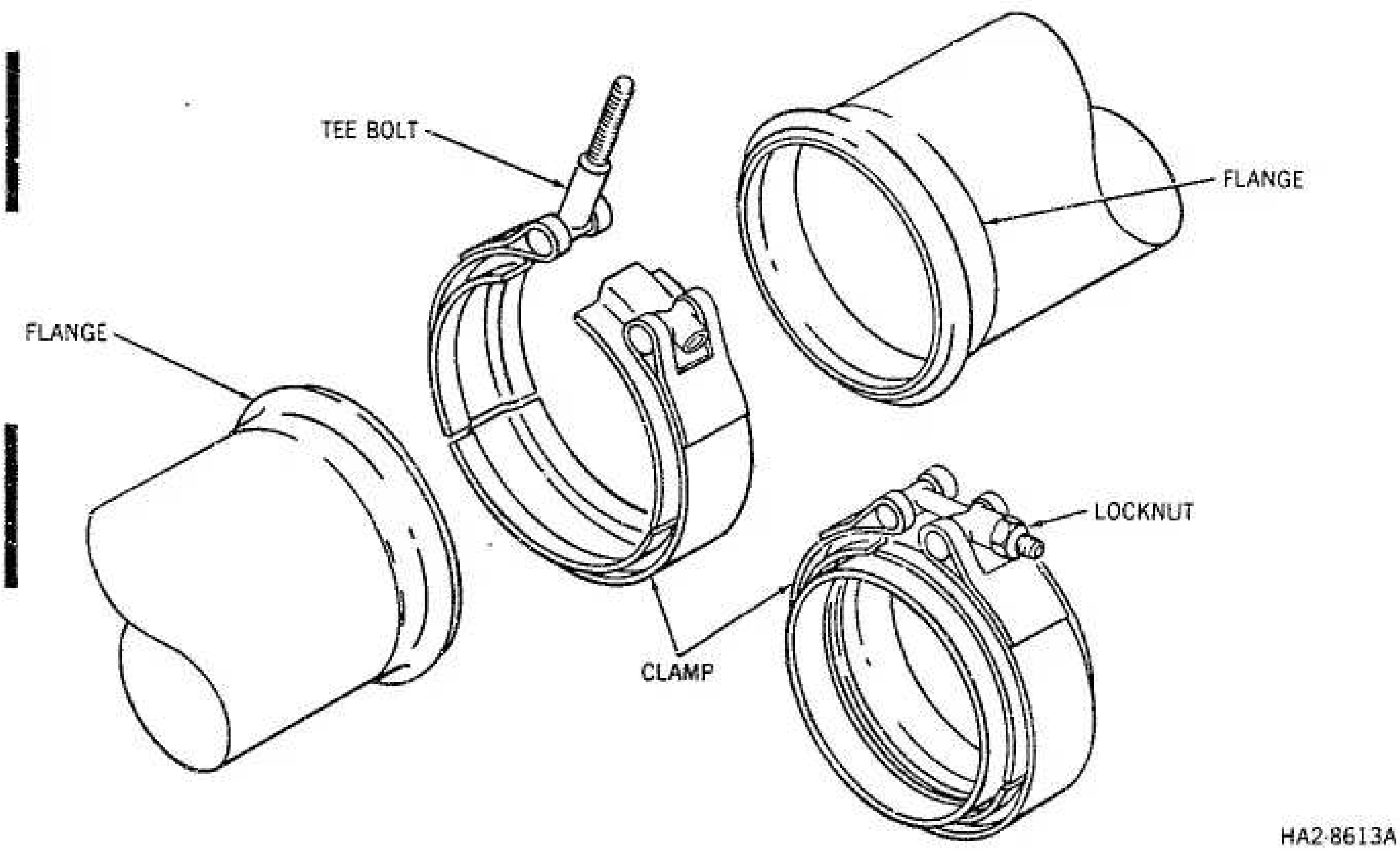
B. Sealant primer (A-4094) is applied to all surfaces to which RTV-1016 or RTV-90 silicone sealant is to be applied, and to all fluid-resistant primed areas where sealant is to be applied.

(1) Thoroughly clean and dry all surfaces to be primed before application of sealant primer (A-4094). Clean with solvent (Douglas No. 14) using clean, white cotton cloth wipers.

<u>NOTE</u>: Sealant primer (A-4094) containers must remain tightly sealed at all times when not in actual use to prevent absorption of moisture from the atmosphere. Primer that has absorbed excessive moisture exhibits a cloudy appearance prior to application and must be discarded, since moisture in the primer results in poor sealant adhesion. Brushes used to apply primer must never be inserted directly into the original container. Instead, sufficient primer for a given application must be transferred to a clean container. Never return unused primer to the original container.



Typical Pneumatic Duct Installation
Figure 203

(2) Apply a thin brush coat of sealant primer (A-4094) on all surfaces to which sealant is to be applied. The primer must not be allowed to form puddles on horizontal surfaces or in confined areas. Excessive primer application is indicated if the coating takes on a milky appearance within 5 minutes after application. If excess application of primer is indicated, immediately wipe with clean, dry cloth to remove milky appearance. Application of additional primer after wiping is not required. To ensure sati-factory adhesion of the sealant, an absolute minimum drying time of 30 minutes must be allowed before sealant is applied. When practicable, extended drying time is recommended.

NOTE: The dry primer forms a nonvisible surface coating. It is extremely important that all primed areas be carefully outlined and protected from incidental handling before sealant is applied.

(3) When patching or tying into cured silicone sealants (RTU-1016 or RTU-90) with uncured material, thoroughly wipe down the tie-in area with sealant primer (A-4094) to ensure proper adhesion of the fresh sealant with the cured sealant.

NOTE: When sealants PR-1422, RTV-1016, or RTU-90 are specified in sealing instructions, the sealant is to be mixed with the proper catalyst unless otherwise specified. These sealants have an application time of 2 1/2 hours after the materials have been removed from refrigeration. See Chapter 13 for instructions on storage, handling, mixing of sealants, and methods of application.

C. Plug all tooling holes in any sealed areas up to and including 1/4 inch in diameter, using driven rivets. Make certain that the upset head of the rivet is inside the sealed area.

D. Seal Cabin Continuous Panels After Installation

(1) Fill all voids and gaps in the inside corners around panel cutouts and on the outside corners around outer edges of panels with sealant (PR-1422).

(2) Fill all voids and apply fillet of sealant (PR-1422) completely around dropper assemblies and panels.

(3) Fill voids and apply a fillet of sealant (PR-1422) on all seams on panels causing excessive leakage during pressure test.

(4) Apply sealant (PR-1422) between bulbs on mechanical seal around both ends of utility ducts installed on side panels.

NOTE: The sealant is to be applied around the ends of the ducts to the first attachment across the top and bottom of the utility ducts. Apply a thin coating of petrolatum on the flange of the utility duct in the area contacting the sealant.

(5) Apply fillet of sealant (PR-1422) around electrical receptacles and pins installed in utility duct.

(6) Apply fillet of sealant (PR-1422) from seat of receptacle installation to the utility duct.

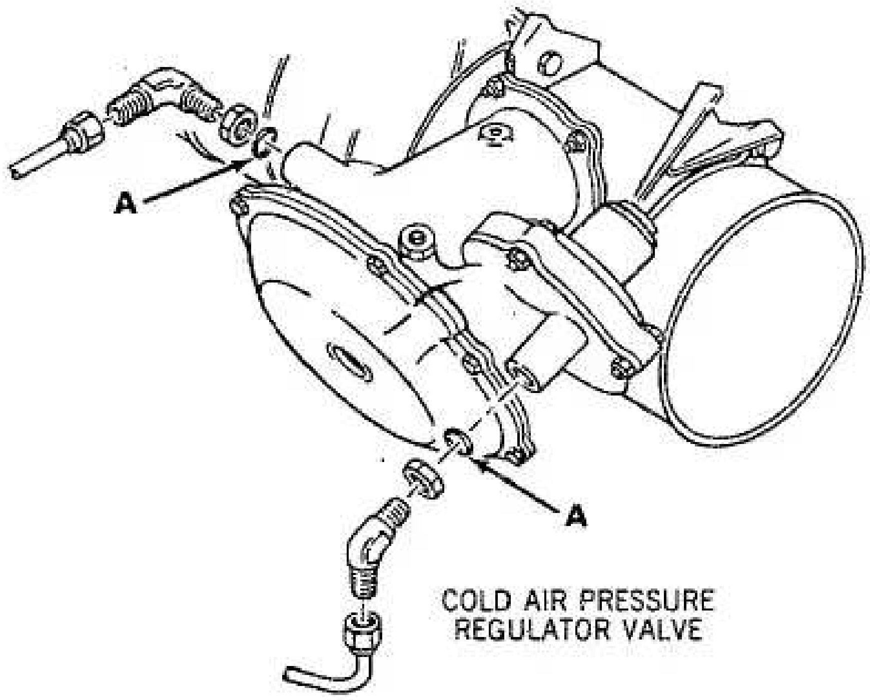
5. O-Ring Information

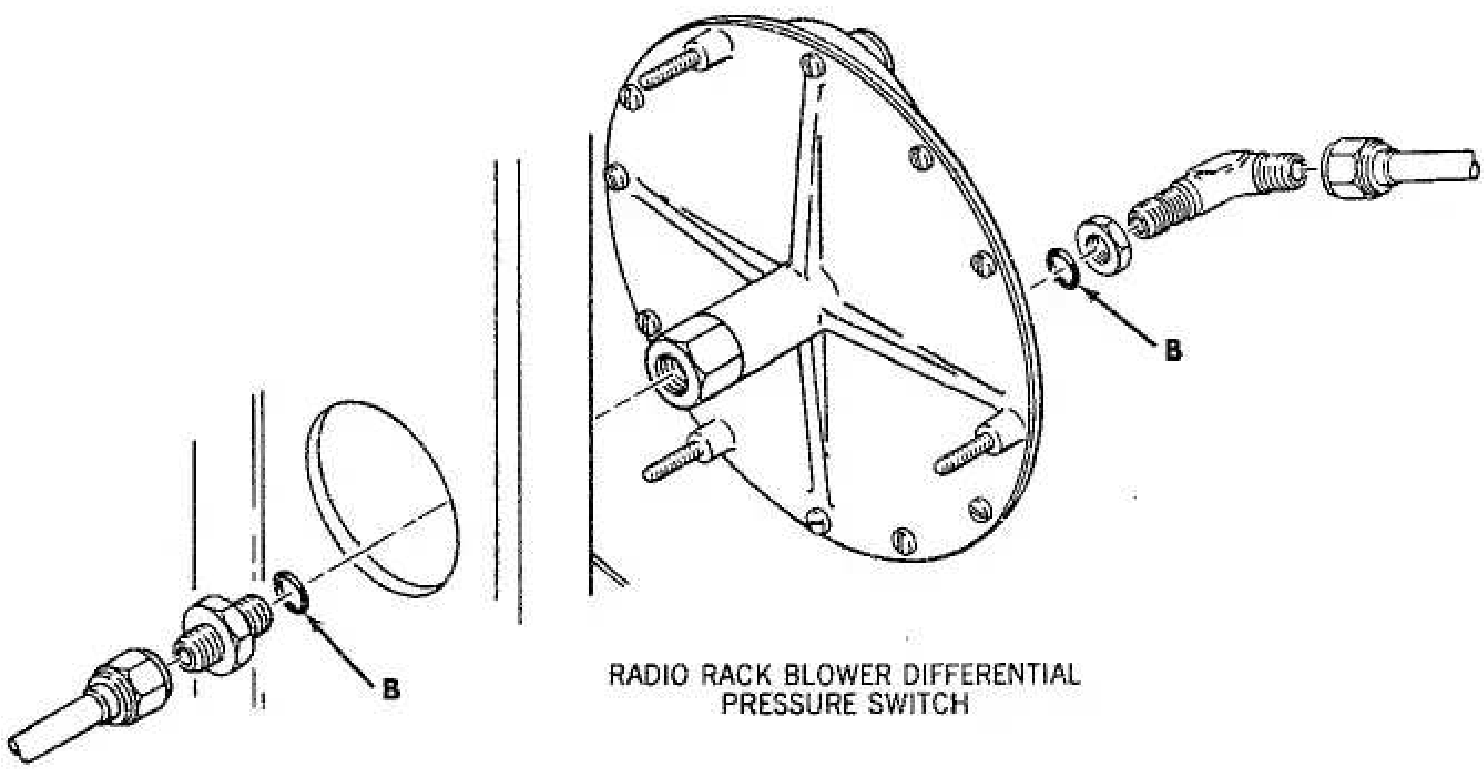
NOTE: The following information is provided to assist in identification and handling of refrigeration system seals.

A. Before installing an O-ring, remove identification markings by carefully scraping off with a fingernail, being careful not to cut O-ring. If necessary soften markings by placing O-ring in soap and water solution. No other solution or compound is recommended. Failure to remove markings could result in leaking seal.

B. The O-rings usually contain a coating or talcum powder, which must be removed before the O-ring is installed. Remove talcum powder by washing in soap and water solution. No other solution is recommended. Dry O-ring thoroughly and apply a light surface film of petroleum base oil. Install O-ring immediately to prevent dust from collecting on oil film.

C. O-rings from disassembled parts should be discarded. O-ring part numbers for all air conditioning system components are shown in Figure 204.

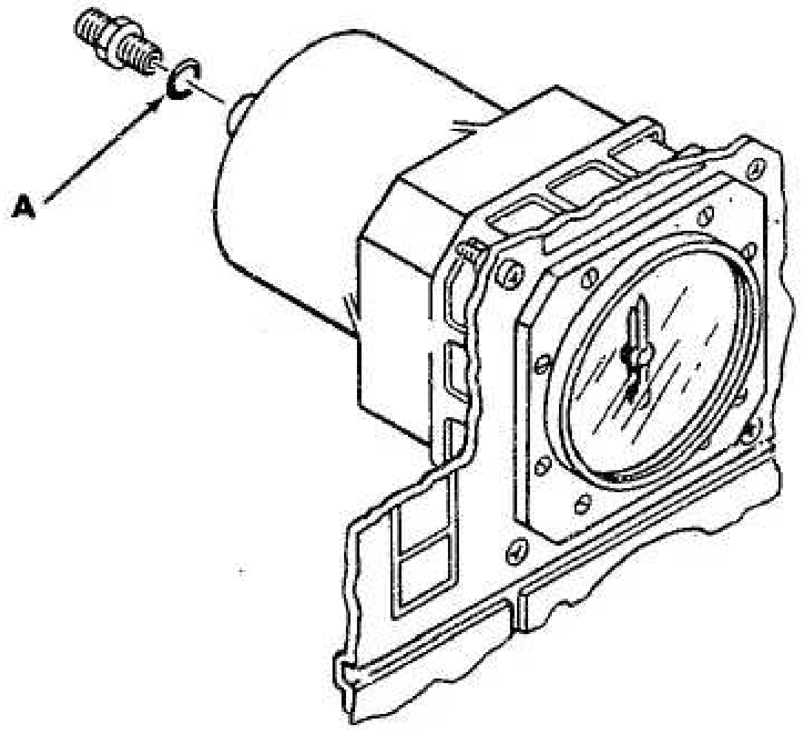




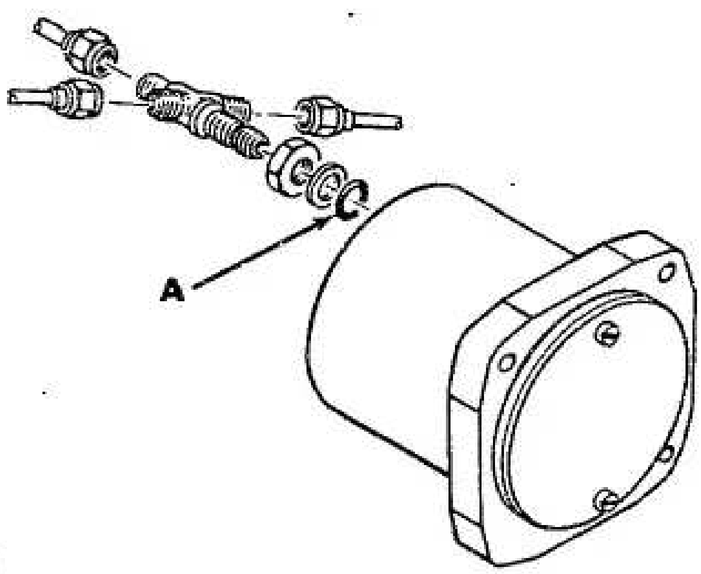
CODE:
A 4615517-515 (DOUGLAS AIRCRAFT CO.)
B MS28778-4

HA2-8614A

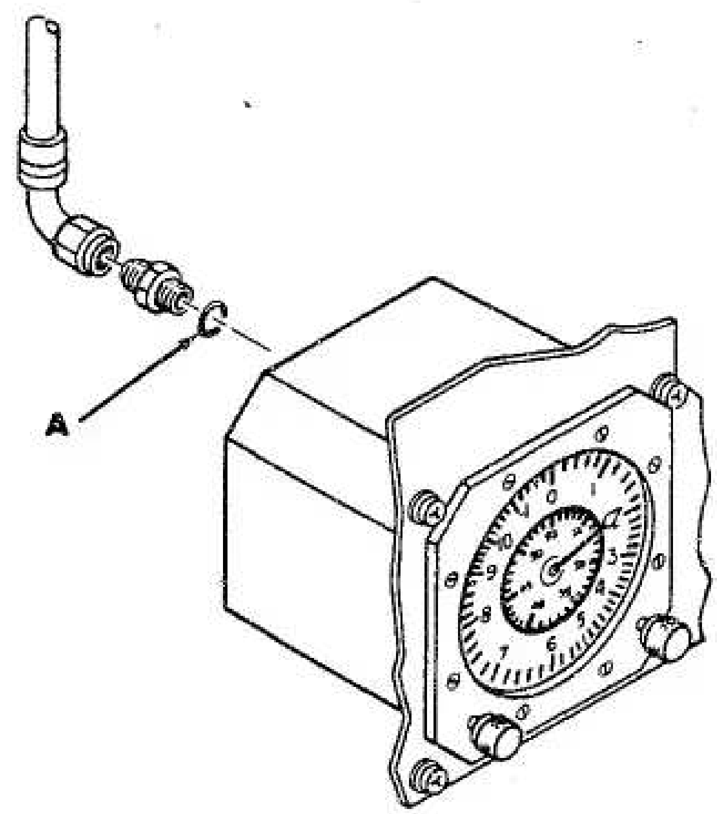
Air Conditioning Components -- O-Rings
Figure 204 (Sheet 1)



CABIN ALTITUDE AND DIFFERENTIAL
PRESSURE INDICATOR



CABIN RATE INDICATOR



CODE:
A MS28778-4

CABIN PRESSURE CONTROLLER
HA2-8615A

Air Conditioning Components -- O-Rings
Figure 204 (Sheet 2)

DISTRIBUTION - DESCRIPTION AND OPERATION

1. General

A. The distribution section is divided into two systems; cabin air recirculating fan control system and distribution systems. The cabin air recirculating fan control section (21-21-0) describes the operation of the recirculating fan and control circuit tie-in with other systems. The distribution systems section (21-22-0) describes duct and valve layout; flow details of ram air, hot air, warm air, cold air, conditioned air, and exhaust air. Also described in this section are details of components not directly related to the control and operation of the recirculating fan.

CABIN AIR RECIRCULATING FAN CONTROL - DESCRIPTION AND OPERATION

1. General (See Figure 1.)

   A. The recirculating fan provides air recirculation from the air-conditioning accessory compartment (pressurized area), through the conditioned air manifold to the distribution system. The fan is manually controlled from the systems engineer control panel. When the airplane electrical buses are energized and the recirculating fan switch is in up position, the fan operates continuously except during ground conditioned air operations.

   B. A check valve is installed downstream from the recirculating fan to prevent backflow of air from the wye duct manifold through the inoperative fan. The ground-conditioned air check valve switch prevents operation of the fan if conditioned air is being delivered from a ground source.

2. Component Description

   A. Recirculating Fan (See Figure 1.)

      (1) The recirculating fan is mounted on the conditioned air wye duct manifold in the air-conditioning accessory compartment. The fan provides the required circulation of air from the pressurized air-conditioning accessory compartment to the air distribution system. The recirculating fan contains a 115 vac, 3-phase electric motor and heat protection circuit. The fan is equipped with bellmouth inlet. The fan is equipped with a filter.

      (2) The recirculating fan switch is two position and turns the recirculating fan on or off. The recirculation fan will be on normally but may be turned off on the ground to facilitate empty cabin temperature pull down.

   B. Recirculating Fan Check Valve

      (1) The recirculating fan check valve is installed in the recirculating fan wye duct manifold. The flapper assembly which forms the check valve is mounted so that the fan outlet port is closed when the fan is not operating.

3. System Operation (See Figure 1.)

   A. Normal flow of air to the passenger and flight compartment from the air-conditioning system is through the conditioned air and cold air distribution ducts. Exhaust air from the passenger compartment flows through grills below the sidewall panels, through openings in the floor structure, to the air-conditioning utility tunnels. With the recirculating fan operating, flow is from the utility tunnels into the air-conditioning

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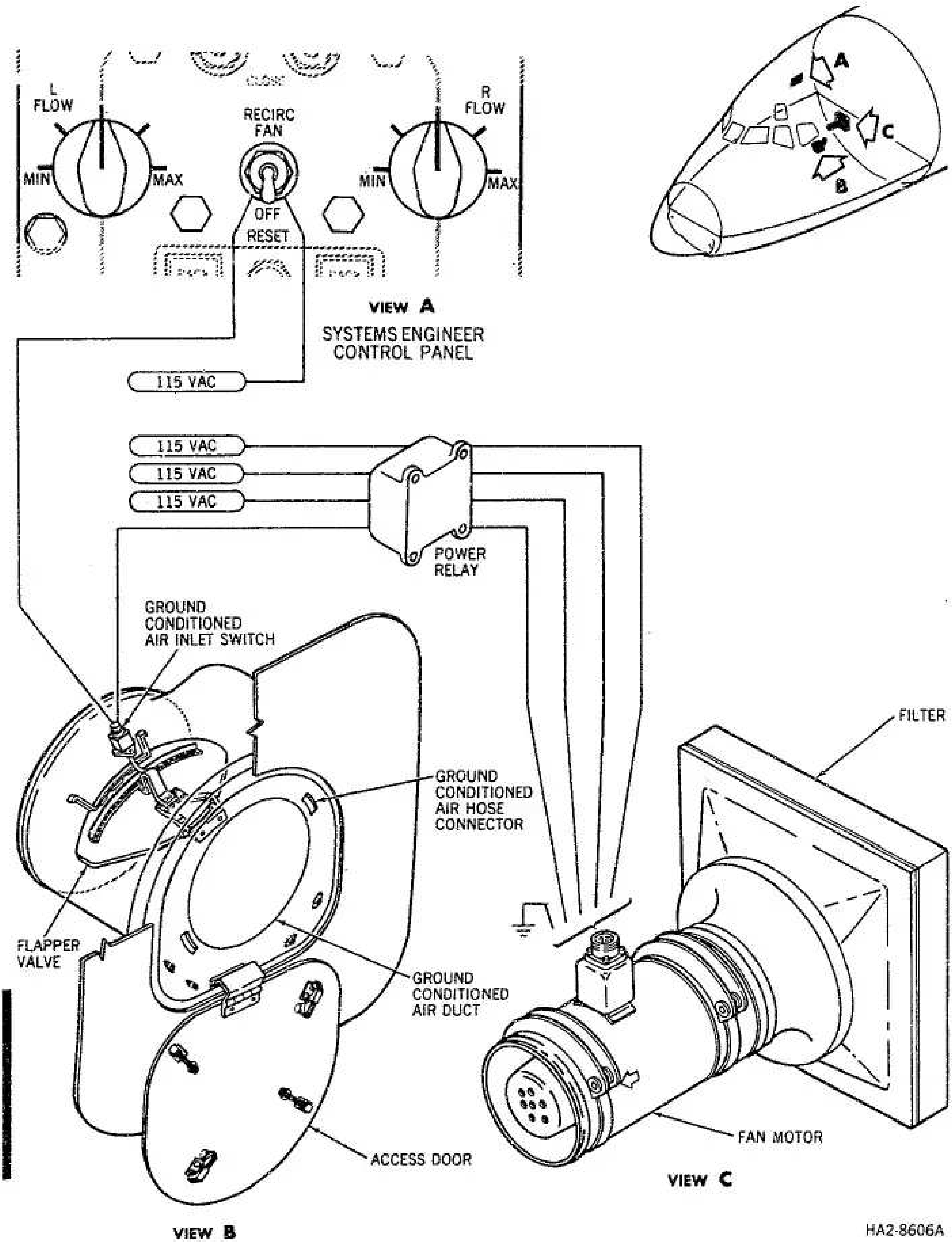

Recirculating Fan -- Operation
Figure 1

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accessory compartment where the recirculating fan is located. The recirculating fan draws air into the recirculating fan manifold for recirculation through the air-conditioning system. A flapper installation downstream to the fan forms a check valve for manifold air when the fan is inoperative.

B. The fan protection circuits (see Figure 2) are energized when power is applied to the recirculating fan. When ground supplied conditioned air is not being delivered, the contacts in the ground conditioned air check valve switch are closed. (The ground conditioned air check valve switch opens to deenergize the fan circuit if ground conditioned air is being delivered into the distribution system at 10 ±2 inches of water pressure.) Closing the recirculating fan switch contacts, energizes the fan power relay with 115 vac, through closed contacts of the ground conditioned air check valve switch and contacts of the fan internal temperature protection sensors. The fan power relay contacts close to energize the fan motor circuits from the generator bus bay, and the fan starts.

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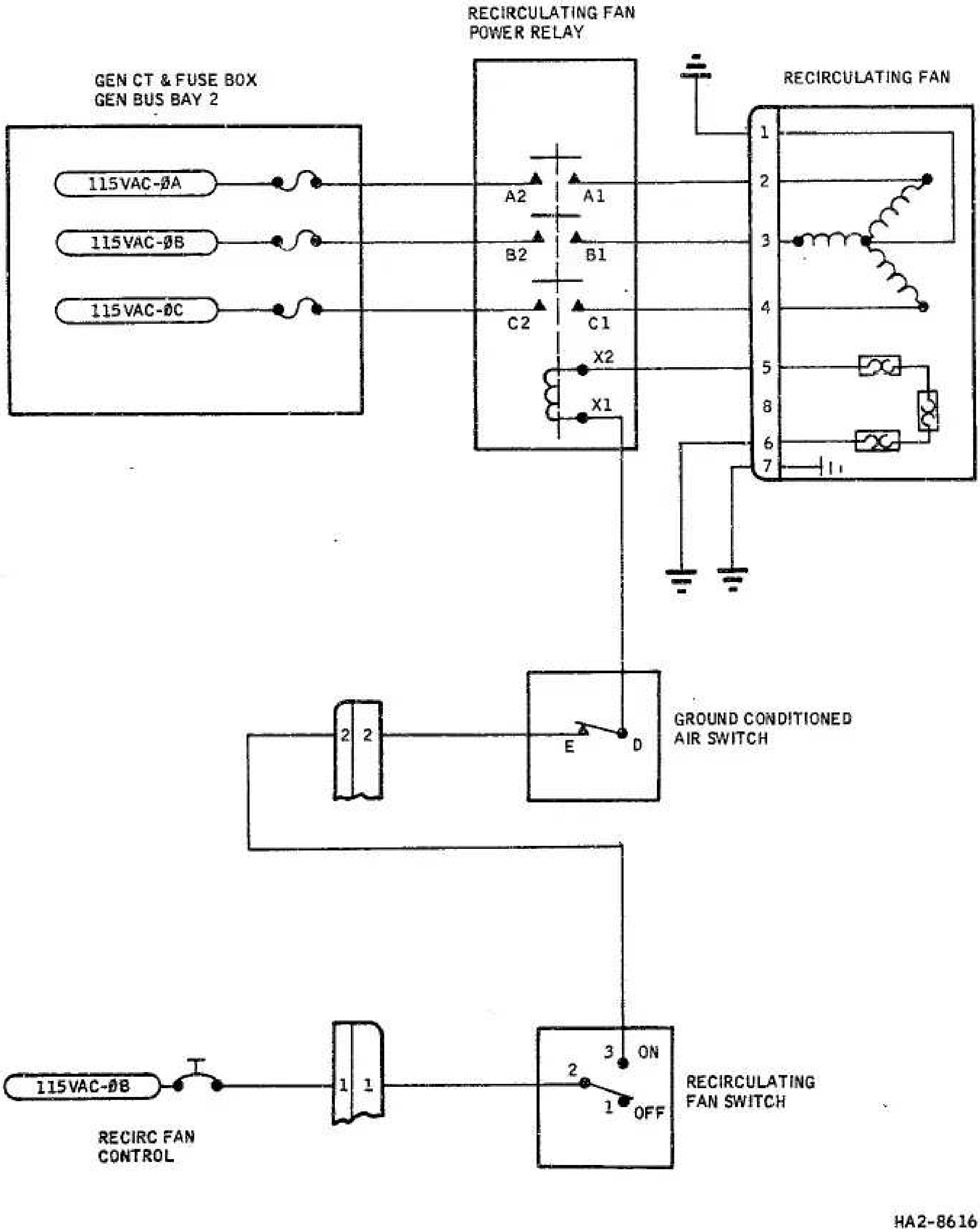

Recirculating Fan Control -- Electrical Schematic
Figure 2

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CABIN AIR RECIRCULATING FAN CONTROL - DESCRIPTION AND OPERATION

1. General (See Figure 1.)

   A. The recirculating fan provides air recirculation from the air-conditioning accessory compartment (pressurized area), through the conditioned air manifold to the distributio system. The fan is manually controlled from the systems engineer control panel. When the airplane electrical buses are energized and the recirculating fan switch is in up position, the fan operates continuously except during ground conditioned air operations.

   B. A check valve is installed downstream from the recirculating fan to prevent backflow of air from the wye duct manifold through the inoperative fan. The ground-conditioned air check valve switch prevents operation of the fan if conditioned air is being delivered from a ground source.

2. Component Description

   A. Recirculating Fan (See Figure 1.)

      (1) The recirculating fan is mounted on the conditioned air wye duct manifold in the air-conditioning accessory compartment. The fan provides the required circulation of air from the pressurized air-conditioning accessory compartment to the air distribution system. The recirculating fan contains a 115 vac, 3-phase electric motor, an overload and heat protection circuit and a manual reset circuit. The fan is equipped with a filter.

      (2) The recirculating fan switch is two position and turns the recirculating fan on or off. The recirculation fan will be on normally but may be turned off on the ground to facilitate empty cabin temperature pull down.

   B. Recirculating Fan Check Valve

      (1) The recirculating fan check valve is installed in the recirculating fan wye duct manifold. The flapper assembly which forms the check valve is mounted so that the fan outlet port is closed when the fan is not operating.

3. System Operation (See Figure 1.)

   A. Normal flow of air to the passenger and flight compartment from the air-conditioning system is through the conditioned air and cold air distribution ducts. Exhaust air from the passenger compartment flows through grills below the sidewall panels, through openings in the floor structure, to the air-conditioning utility tunnels. With the recirculating fan operating, flow is from the utility tunnels into the air-conditioning

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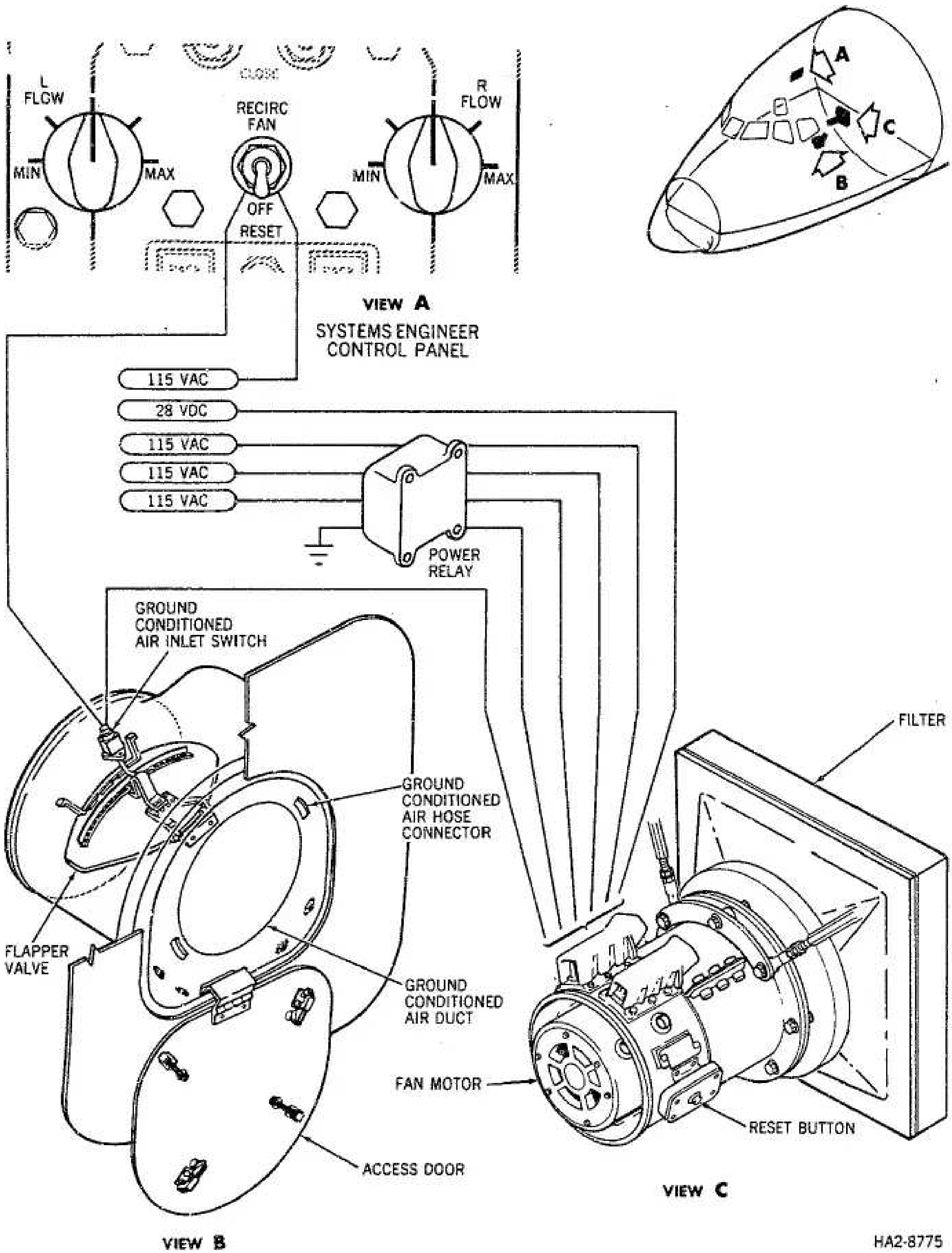

Recirculating Fan -- Operation
Figure 1

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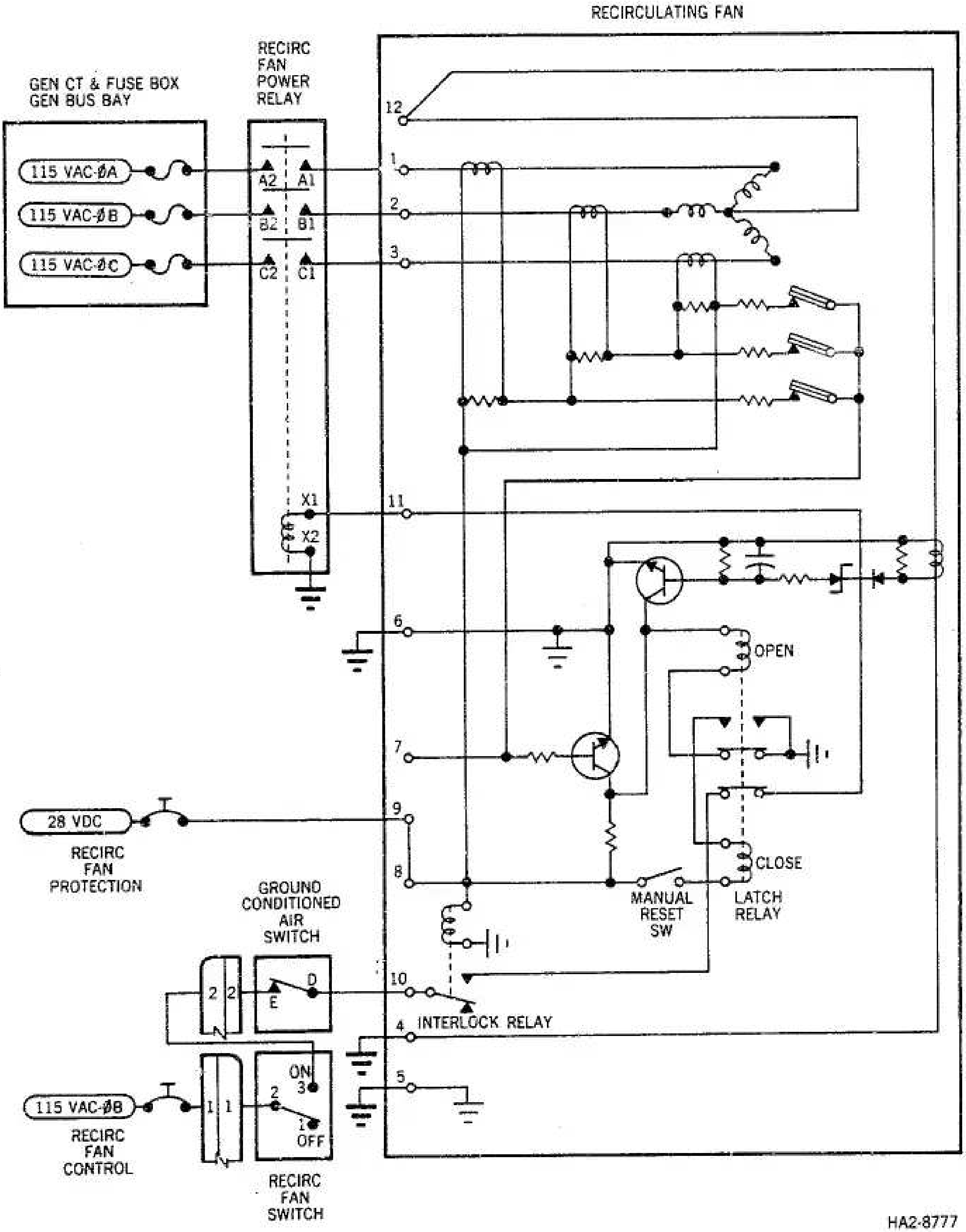
accessory compartment where the recirculating fan is located. The recirculating fan draws air into the recirculating fan manifold for recirculation through the air-conditioning system. A flapper installation downstream to the fan forms a check valve for manifold air when the fan is inoperative.

B. The fan protection circuits (see Figure 2) are energized when 28vdc is applied to the airplane electrical buses, and the protection relays are energized to close the relay contacts. The double-coil latching relay in the fan is also energized to close the contacts. When ground supplied conditioned air is not being delivered, the contacts in the ground conditioned air check valve switch are closed. (The ground conditioned air check valve switch opens to deenergize the fan circuit if ground conditioned air is being delivered into the distribution system at 10 ±2 inches of water pressure.) Closing the recirculating fan switch contacts, energizes the fan power relay with 115 vac, through closed contacts of the ground conditioned air check valve switch and contacts of the fan internal relays. The fan power relay contacts close to energize the fan motor circuits from the generator bus bay, and the fan starts.



Recirculating Fan Control -- Electrical Schematic
Figure 2

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CABIN AIR RECIRCULATING FAN CONTROL - TROUBLE SHOOTING

1. General

A. A simplified schematic is provided in the description and operation section. When electrical circuits are to be checked at specific pins and connectors, reference should be made to the Wiring Diagram Manual. Trouble shooting should not be performed when conditioned air is being delivered from a ground source as the ground conditioned air check valve switch is open and the fan control circuit is deenergized.

B. The ground conditioned air check valve switch is flapper actuated and is mounted on the ground conditioned air manifold.

2. Trouble Shooting

Possible Causes	Isolation Procedure	Correction
A. RECIRCULATING FAN DOES NOT OPERATE WHEN RECIRCULATING FAN SWITCH IS PLACED IN ON POSITION		
(1) Defective fan	Disconnect electrical connector from recirculating fan and check for continuity between pins 5 and 6 of recirculating fan.	If continuity exists, perform next check. If no continuity, replace recirculating fan.
	Check for 3-phase, 115 vac at pins 2,3, and 4 with jumper between pin 5 and ground.	If 115 vac is present, replace recirculating fan. If not present, proceed to step (2).
	Connect electrical connector	
(2) Defective recirculating fan power relay.	Check for 115 vac at terminals A2, B2, and C2 of recirculating fan power relay.	If 115 vac is present, perform next check. If not present, check airplane wiring to fuse.

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Possible Causes	Isolation Procedure	Correction
A. RECIRCULATING FAN DOES NOT OPERATE WHEN RECIRCULATING FAN SWITCH IS PLACED IN ON POSITION (Continued)		
	Check for 115 vac at terminal X1 of fan power relay and for continuity between terminal X2 and ground.	If 115 vac is present and continuity exists, replace relay.
		If 115 vac is not present, proceed to next step.
		If no continuity, repair wiring.
(3) Inoperative ground condition air check valve switch.	Open recirculating fan control circuit breaker, disconnect electrical connector from check valve switch, and close circuit breaker. Check for 115 vac at pin E.	If 115 vac is present at pin E, perform next check.
	Check for continuity between pins E and D of check valve switch.	If no continuity, replace switch.
		If 115 vac is not present and continuity exists, proceed to next step.
	Connect electrical connector.	
(4) Defective fan switch.	Disconnect electrical connector from systems engineer lower left control panel and check for continuity between pins 1 and 2.	If continuity exists, check airplane wiring between circuit breaker, control panel, and recirculating fan power relay.
		If no continuity, replace switch.
	Connect electrical connectors.	

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CABIN AIR RECIRCULATING FAN CONTROL - TROUBLE SHOOTING

1. General

A. A simplified schematic is provided in the description and operation section. When electrical c'rcuits are to be checked at specific pins and connectors, reference should be made to the Wiring Diagram Manual. Trouble shooting should not be performed when conditioned air is being delivered from a ground source as the ground conditioned air check valve switch is open and the fan control circuit is deenergized.

B. The ground conditioned air check valve switch is flapper actuated and is mounted on the ground conditioned air manifold. If fan does not start, press the reset button on the fan housing prior to starting trouble-shooting procedures.

2. Trouble Shooting

Possible Causes	Isolation Procedure	Correction
A. RECIRCULATING FAN DOES NOT OPERATE WHEN RECIRCULATING FAN SWITCH IS PLACED IN ON POSITION		
(1) Fan reset-circuit tripped		Press reset button on fan.
(2) Defective fuse.	Check for defective fuse at generator bus bay (see Wiring Diagram Manual).	Replace defective fuse.
(3) Defective fan.	Check for 28 vdc at terminal 9 of recirculating fan.	If 28 vdc is present, perform next check. If not present, check airplane wiring between fan and fan protection circuit breaker.
	Check for 115 vac at terminal 10 of recirculating fan.	If 115 vac is present, perform next check. If not present, proceed to step that checks ground conditioned air check valve switch.

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Possible Causes	Isolation Procedure	Correction
A. RECIRCULATING FAN DOES NOT OPERATE WHEN RECIRCULATING FAN SWITCH IS PLACED IN ON POSITION (Continued)		
	Check for 3-phase, 115 vac at terminals 1,2, and 3 of recirculating fan.	If 115 vac is present, replace recirculating fan.
		If not present, proceed to step (4).
(4) Defective recirculating fan power relay.	Check for 115 vac at terminals A2, B2, and C2 of recirculating fan power relay.	If 115 vac is present, perform next check.
		If not present, check airplane wiring to fuse.
	Check for 115 vac at terminal X1 of fan power relay and for continuity between terminal X2 and ground.	If 115 vac is present and continuity exists, replace relay.
		If 115 vac is not present, proceed to next step.
		If no continuity, repair wiring.
(5) Inoperative ground condition air check valve switch.	Open recirculating fan control circuit breaker, disconnect electrical connector from check valve switch, and close circuit breaker. Check for 115 vac at pin E.	If 115 vac is present at pin E, perform next check.
	Check for continuity between pins E and D of check valve switch.	If no continuity, replace switch.
		If 115 vac is not present and continuity exists, proceed to next step.
	Connect electrical connector.	

Possible Causes	Isolation Procedure	Correction
A. RECIRCULATING FAN DOES NOT OPERATE WHEN RECIRCULATING FAN SWITCH IS PLACED IN ON POSITION (Continued)		
(6) Defective fan switch.	Disconnect electrical connector from systems engineer lower left control panel and check for continuity between pins 1 and 2.	If continuity exists, check airplane wiring between circuit breaker, control panel, and recirculating fan power relay. If no continuity, replace switch.
	Connect electrical connectors.	

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CABIN AIR RECIRCULATING FAN CONTROL - MAINTENANCE PRACTICES

1. General

A. The cabin air recirculating fan control system test checks the ability of the fan to start within a limited time during system operation. The test checks the operation of the fan during ground conditions.

2. Adjustment/Test Cabin Air Recirculating Fan Control

A. Test Recirculating Fan Operation

(1) Place recirculating fan switch in up position. Check that fan starts.

(2) Place recirculating fan switch in off position. Fan should stop.

(3) Open ground conditioned air access door, located on fuselage nose right side, and manually hold ground conditioned air check valve flapper fully open taking care not to distort flapper.

(4) Place recirculating fan switch in on position. Fan should not operate.

(5) Place recirculating fan switch in off position.

(6) Release ground conditioned air check valve flapper.

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RECIRCULATING FAN - MAINTENANCE PRACTICES

1. General

A. The recirculating fan is installed on the wye duct manifold in the air-conditioning accessory compp--tment. A filter is installed on the fan intake.

B. Access to the recirculating fan and the filter is through the air-conditioning accessory compartment lower access door.

2. Servicing Recirculating Fan

A. The recirculating fan filter should be cleaned periodically. The filter is removed by releasing two camloc fasteners.

3. Removal/Installation Recirculating Fan (See Figure 201)

A. Remove Recirculating Fan

(1) Open recirculating fan control circuit breaker, located on heat, vent, and ice protection ac section of EPC circuit breaker panel.

(2) Disconnect electrical connector from fan.

(3) Remove filter installation.

(4) Disconnect wye duct expander-to-fan clamp.

(5) Disconnect fan support rods, and remove fan.

B. Install Recirculating Fan

(1) Make certain that recirculating fan control circuit breaker, located on heat, vent, and ice protection ac section of EPC circuit breaker panel, is open.

(2) Connect support rods to fan.

(3) Position fan and loosely install wye duct expander-to-fan clamp.

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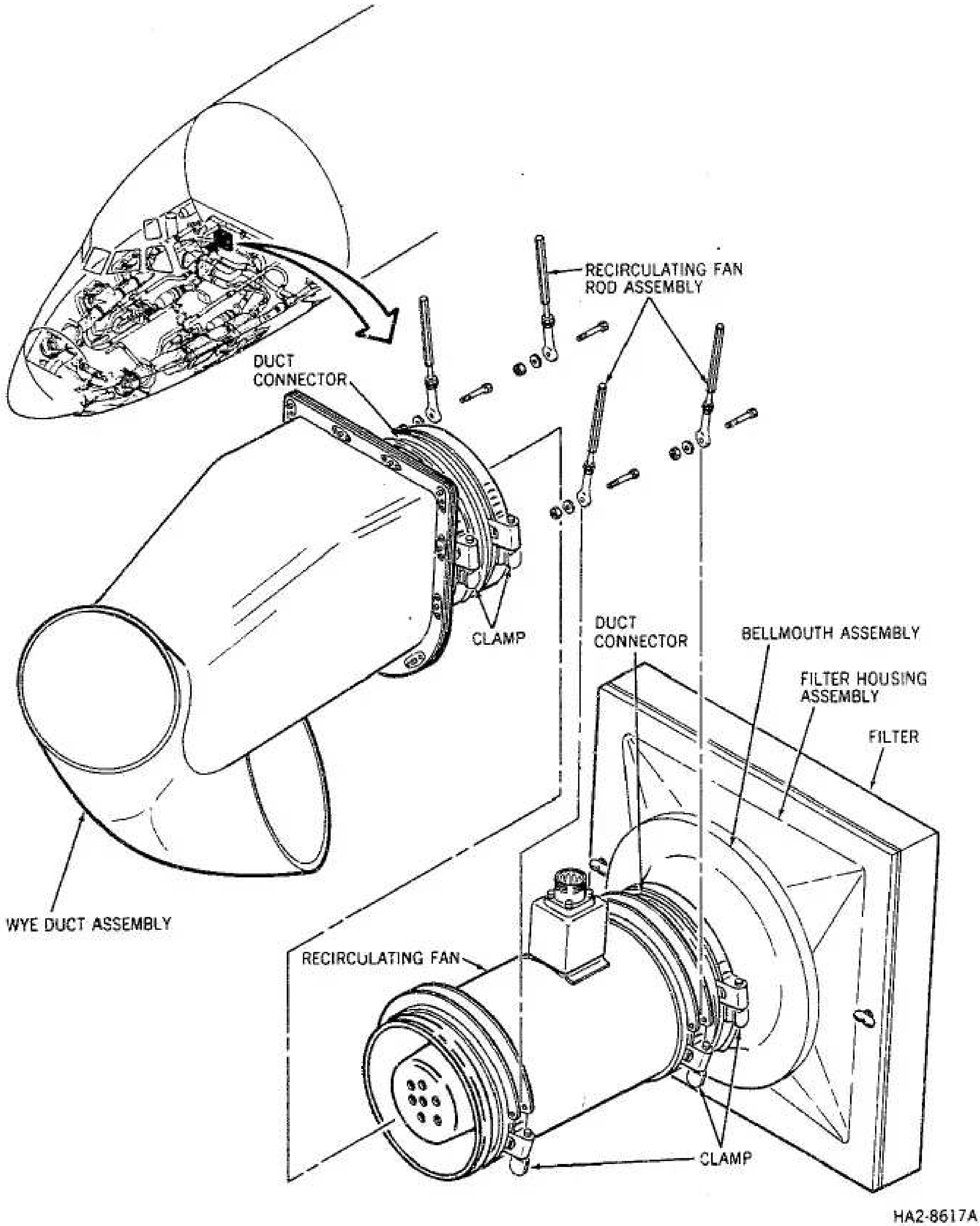

Recirculating Fan -- Installation
Figure 201

(4) Tighten wye duct expander-to-fan clamp.

(5) Install filter.

(6) Connect electrical connector.

(7) Close recirculating fan control circuit breaker.

(8) Test recirculating fan (see paragraph 4).

(9) Leak check recirculating fan (see paragraph 5).

4. Adjustment/Test Recirculating Fan

A. Test Recirculating Fan

NOTE: Recirculating fan does not operate when ground conditioned air is being delivered from a ground source through the ~~ground conditioned~~ air connection.

(1) Place recirculating fan switch in up position. Check that fan attains operating speed.

(2) Place recirculating fan switch in off position.

5. Inspection/Check Recirculating Fan

A. Leak Check Recirculating Fan

NOTE: Recirculating fan does not operate when ground conditioned air is being delivered from a ground source through the ground conditioned air connection.

(1) Place recirculating fan switch in on position. Check that fan attains operating speed.

(2) Check for leaks by sound and feel at fan connections.

(3) Place recirculating fan switch to off position.

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RECIRCULATING FAN - MAINTENANCE PRACTICES

1. General

A. The recirculating fan is installed on the wye duct manifold in the air-conditioning accessory comp·rtment. A filter is installed on the fan intake.

B. Access to the recirculating fan and the filter is through the air-conditioning accessory compartment lower access door.

2. Servicing Recirculating Fan

A. The recirculating fan filter should be cleaned periodically. The filter is removed by releasing two camloc fasteners.

3. Removal/Installation Recirculating Fan (See Figure 201)

A. Remove Recirculating Fan

(1) Open recirculating fan control circuit breaker, located on heat, vent, and ice protection ac section of EPC circuit breaker panel.

(2) Open applicable recirculating fan protection circuit breaker, located on heat, vent, and ice protection dc section of EPC circuit breaker panel.

(3) Tag and disconnect electrical wires from fan.

(4) Remove filter installation.

(5) Disconnect tension cable assembly from fan support to frame.

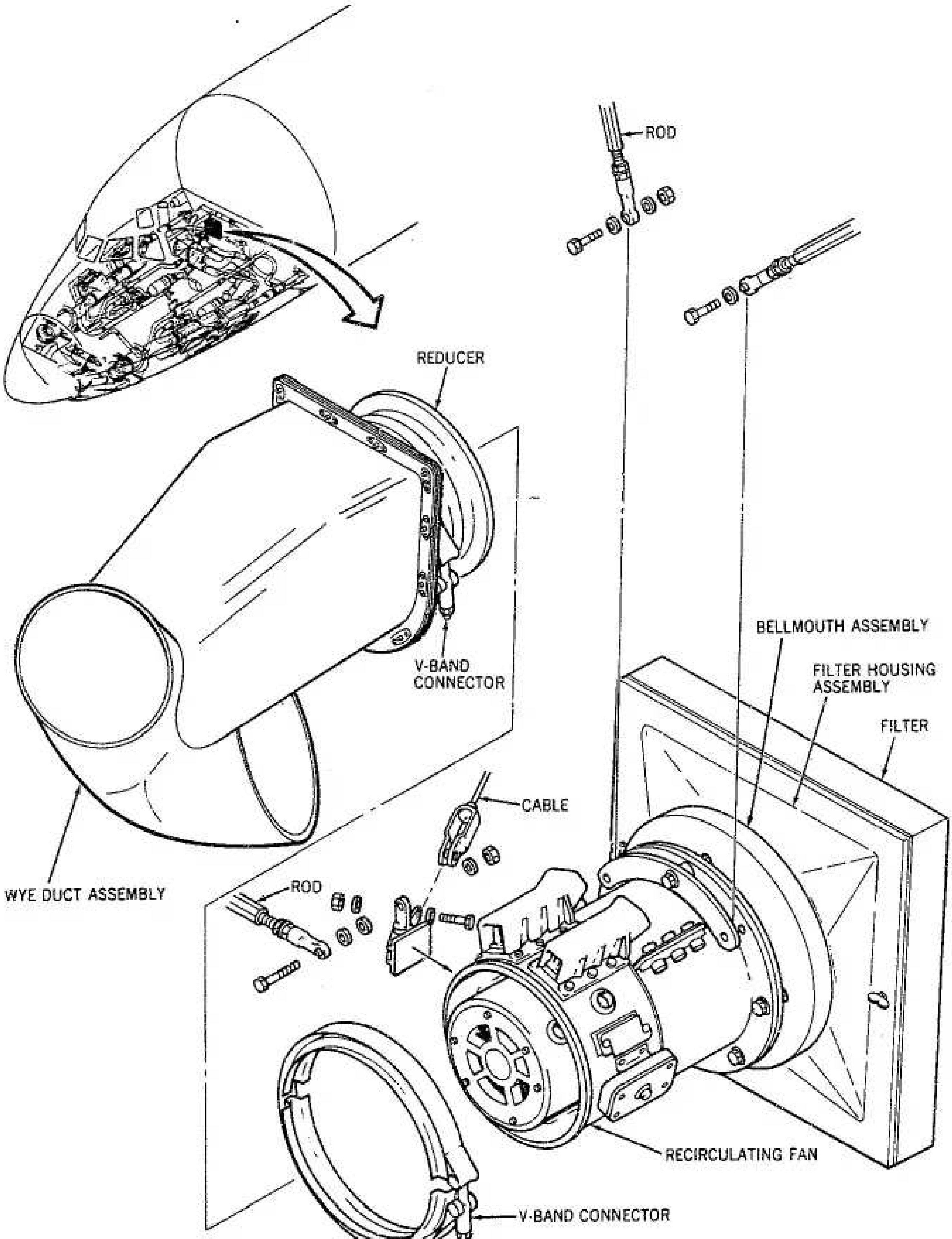
(6) Disconnect wye duct reducer-to-fan clamp.

(7) Disconnect fan support rods, and remove fan.

B. Install Recirculating Fan

(1) Make certain that recirculating fan control circuit breaker, located on heat, vent, and ice protection ac section of EPC circuit breaker panel, is open.

(2) Make certain that applicable recirculating fan protection circuit breaker, located on heat, vent, and ice protection dc section of EPC circuit breaker panel, is open.


ROD
REDUCER
V-BAND CONNECTOR
BELLMOUTH ASSEMBLY
FILTER HOUSING ASSEMBLY
FILTER
CABLE
WYE DUCT ASSEMBLY
ROD
RECIRCULATING FAN
V-BAND CONNECTOR
HA2-8776

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(3) Connect support rods to fan.

(4) Connect tension cable assembly from fan support to frame.

R (5) Position fan and loosely install wye duct reducer-to-fan clamp.

(6) Tighten wye duct reducer-to-fan clamp.

(7) Install filter.

(8) Connect electrical wires.

(9) Close recirculating fan control circuit breaker.

(10) Close recirculating fan protection circuit breaker.

(11) Test recirculating fan (see paragraph 4).

(12) Leak check recirculating fan (see paragraph 5).

4. Adjustment/Test Recirculating Fan

A. Test Recirculating Fan

NOTE: Recirculating fan does not operate when ground conditioned air is being delivered from a ground source through the ground conditioned air connection.

(1) Place recirculating fan switch in up position. Check that fan attains operating speed.

(2) Place recirculating fan switch in off position.

5. Inspection/Check Recirculating Fan

A. Leak Check Recirculating Fan

NOTE: Recirculating fan does not operate when ground conditioned air is being delivered from a ground source through the ground conditioned air connection.

(1) Place recirculating fan switch in on position. Check that fan attains operating speed.

(2) Check for leaks by sound and feel at fan connections.

(3) Place recirculating fan switch to off position.

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MAINTENANCE MANUAL

RECIRCULATING FAN CHECK VALVE

MAINTENANCE PRACTICES

1. General

A. A recirculating fan check valve is installed on the wye duct flapper assembly.

B. Access to the check valve is through the air-conditioning accessory compartment lower access door.

2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Solvent	No. 15	Douglas Aircraft Co., Inc.	Remove sealant from flapper assembly
B	Sealant	PR-1422 3145 RTV	Dow-Corning	Bond and seal gasket to flapper assembly

3. Removal/Installation Recirculating Fan Check Valve (See Figure 201)

A. Remove Check Valve

(1) Remove wye duct expander.

(2) Remove flapper assembly from recirculating fan wye duct.

B. Install Check Valve

(1) Install flapper assembly to recirculating fan wye duct.

(2) Install wye duct expander.

(3) Tighten wye duct expander clamps. Tighten to torque of 30 inch-pounds.

(4) Test check valve by performing recirculating fan test (see 21-21-1).

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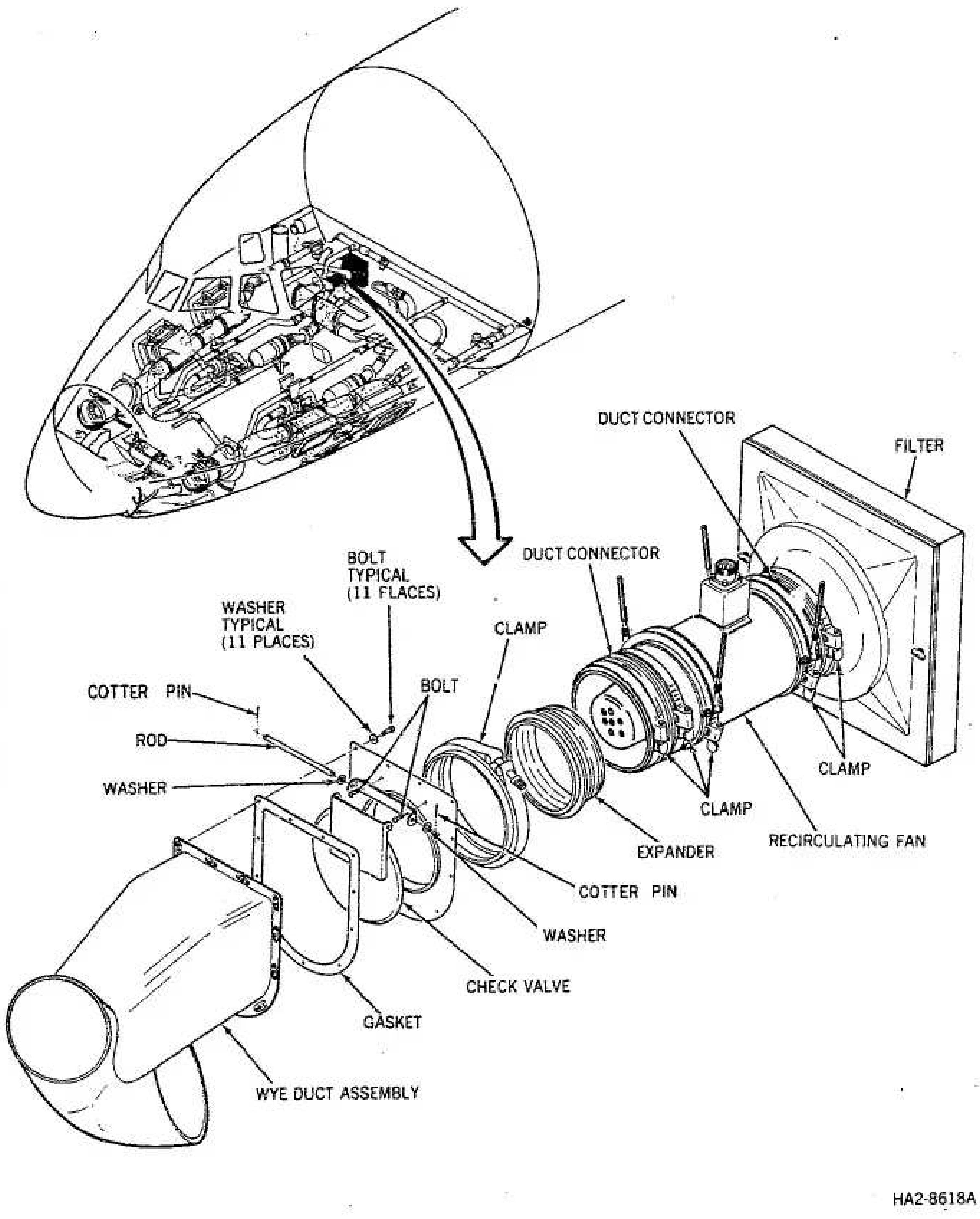

Recirculating Fan Check Valve -- Installation

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4. Inspection/Check Recirculating Fan Check Valve

A. Leak Check Valve Installation

(1) Start air conditioning packs (see 21-00, Description and Operation).

(2) Check for leaks by sound and feel at recirculating fan intake.

(3) Stop air conditioning packs.

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RECIRCULATING FAN CHECK VALVE

MAINTENANCE PRACTICES

1. General

   A. A recirculating fan check valve is installed on the wye duct flapper assembly.

   B. Access to the check valve is through the air-conditioning accessory compartment lower access door.

2. Tools and Equipment Required

   NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Solvent	No. 15	Douglas Aircraft Co., Inc.	Remove sealant from flapper assembly
B	Sealant	PR-1422 3145 RTV	Dow-Corning	Bond and seal gasket to flapper assembly

3. Removal/Installation Recirculating Fan Check Valve (See Figure 201)

   A. Remove Check Valve

      (1) Remove wye duct reducer.

      (2) Remove flapper assembly from recirculating fan wye duct.

   B. Install Check Valve

      (1) Install flapper assembly to recirculating fan wye duct.

      (2) Install wye duct reducer.

      (3) Tighten wye duct reducer clamps. Tighten to torque of 30 inch-pounds.

      (4) Test check valve by performing recirculating fan test (see 21-21-1).

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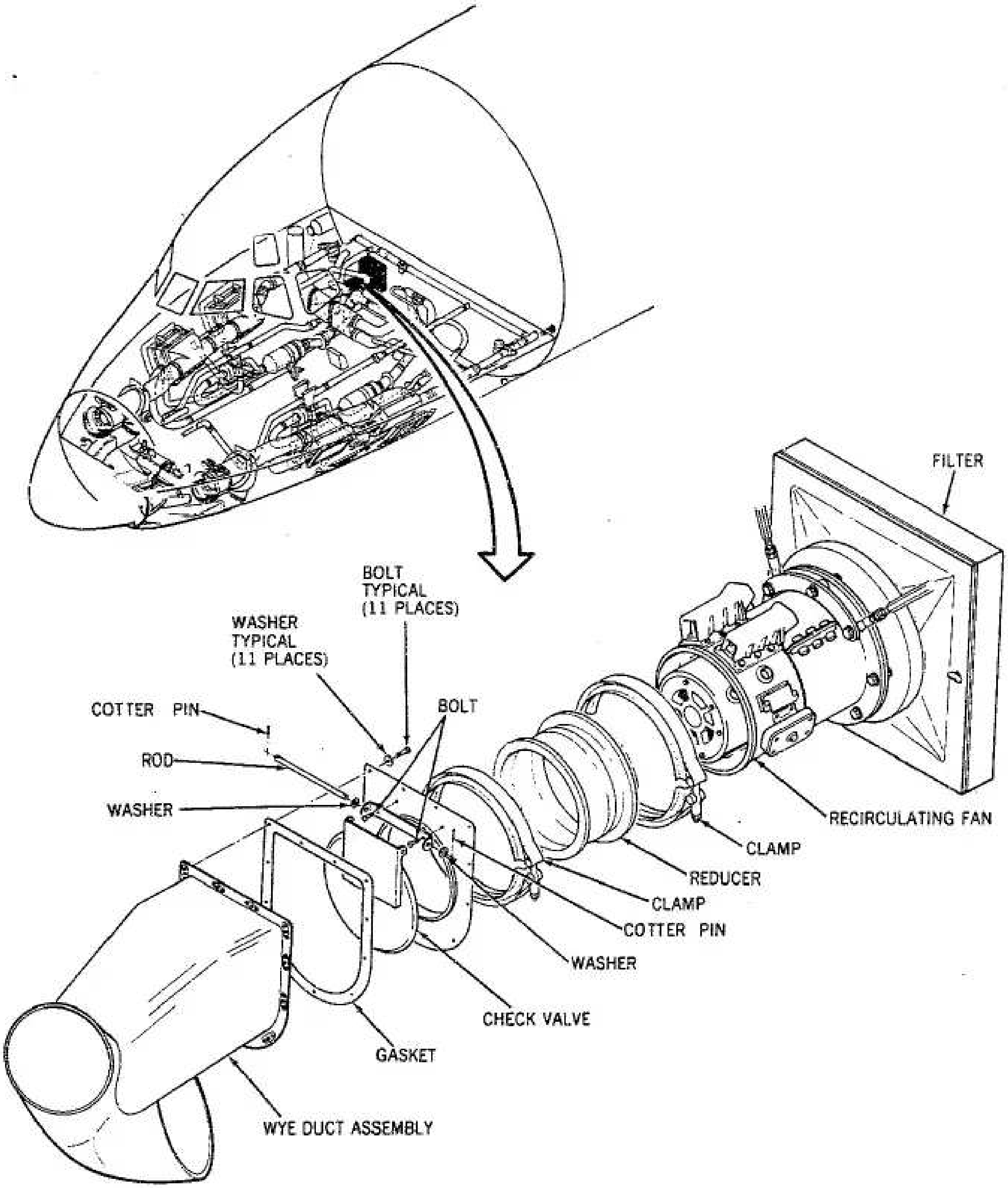

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4. Inspection/Check Recirculating Fan Check Valve

A. Leak Check Valve Installation

(1) Start air conditioning packs (see 21-00, Description and Operation).

(2) Check for leaks by sound and feel at recirculating fan intake.

(3) Stop air conditioning packs.

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DOUGLAS AIRCRAFT CO., INC.
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MAINTENANCE MANUAL

DISTRIBUTION SYSTEMS - DESCRIPTION AND OPERATION

1. General

A. The distribution systems direct the flow of ram air, hot air, intermediate (warm) air, cold air, conditioned air, and exhaust air. Although the flight and passenger compartment air conditioning systems operate independently of each other, the total conditioned air output from the right and left air-conditioning mixing valves are combined in a single (pant leg) duct. By combining the output of the two air conditioning systems before distribution, excess air from the flight compartment (left) air conditioning system is available to augment passenger compartment requirements. Either system can supply conditioned air to both passenger and flight compartments if necessary.

B. Conditioned air is formed by mixing controlled amounts of hot, warm, and cold air in the air-conditioning mixing valves. Low pressure pneumatic air is inducted into two air conditioning systems which then deliver fresh, hot, pressurized air. Warm air is obtained by ducting this air through heat exchangers and cold air is obtained by ducting warm air through air cycle machines. Ram air provides heat exchanger cooling.

C. Ground conditioned air supply ducting in the airplane is used to transfer conditioned air from a ground source to the conditioned air ducting of the passenger and flight compartments.

2. Description

A. Ram Air Ducting (See Figure 1.)

(1) Two ram airscoops located in the airplane nose, one on each side of the
R centerline, are connected to ram air duct diverter valves. Two ground cooling fans and pack cooling fan inlet doors located in the airplane nose are used for cooling when the airplane is on the ground. The pack cooling fans are also connected to the ram air duct diverter valve. Each ram air diverter valve has a flapper to cover either the ram air
R port or the ground cooling fan port. The diverter valve outlet is connected to the ram air ducting. The two main ram air ducts are installed in the lower section of the airplane nose, around the nosewheel well structure, and connected to the right and left heat exchangers.

B. Hot Air Supply Ducting

(1) Hot air ducting is provided for each air conditioning system from low pressure pneumatic air of engines 1 and 2 on the left side and from engines 3 and 4 on the right side. Ducting is routed at the outlets of the left pack flow control and shutoff valve to a T-duct. One outlet of the T-duct is connected to the heat exchanger inlet header;

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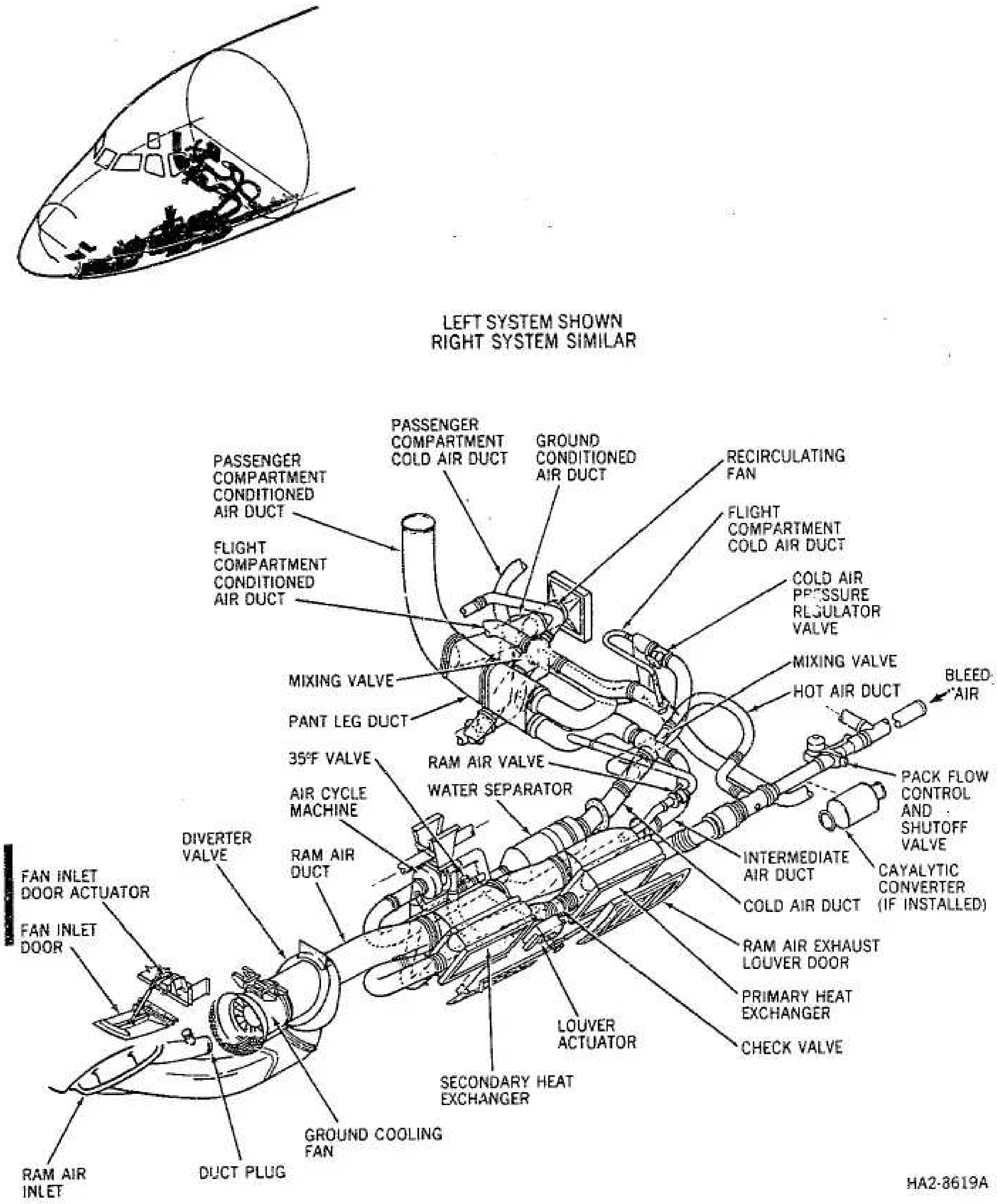

Air Supply Distribution - Component Location
Figure 1

TOC

the other outlet is connected to a duct run that ends at the hot port of the air-conditioning mixing valve in the air-conditioning accessory compartment. Right air conditioning pack is similarly connected on the right side.

C. Intermediate (Warm) Air Supply Ducting

(1) Warm air supply ducts begin at each secondary heat exchanger outlet and routed to the warm air check valves mounted on the right and left sides of the pressure bulkhead in the air-conditioning accessory compartment. A duct is routed from each check valve to the corresponding air-conditioning mixing valve warm air port.

D. Cold Air Supply and Distribution Ducting

(1) The cold air supply ducts are connected between the air cycle machines and cold ports of the air-conditioning mixing valves (see Figure 1). A welded duct section from the left cold air supply check valve is connected to the cold air pressure regulator valve. Passenger compartment cold air distribution ducts are routed aft below the floor, then upward to the overhead stowage racks on each side of the passenger compartment (see Figure 2). Outlets in the cold air ducts provide for multiseat arrangements. From the main distribution duct, flex hoses are directed to utility boxes in the overhead stowage racks, which house the cold air outlet valves (see Figure 3). These outlets are adjustable to control the amount and direction of cold airflow. In the flight compartment, cold air ducts are routed from the cold air supply to adjustable outlets for each crew member.

E. Conditioned Air Distribution Ducting

(1) Conditioned air distribution begins at the outlet ports of each air-conditioning mixing valves. Both outlets are connected to a single (pant leg) duct that forms the main supply duct for the passenger compartment. An outlet for the flight compartment conditioned air is provided from the side of the pant leg duct connected to the left pack.

(2) The flight compartment conditioned air main distribution ducts are routed forward to the right and left sides of the air-conditioning accessory compartment (see Figure 4). The left duct installation contains a muffler below the flight compartment floor, ducts that branch to an overhead diffuser, and ducts that are routed forward to an adjustable outlet at the left forward panel installation. The right duct installation contains ducts that are routed upward through the flight compartment floor, and through a muffler installed adjacent to the airplane skin to an overhead diffuser. Another duct runs forward to adjustable outlets at the right forward panel installation.

(3) The passenger compartment main conditioned air duct is routed upward from the air-conditioning accessory compartment through a muffler to overhead ducts above the ceiling. The overhead ducts are located

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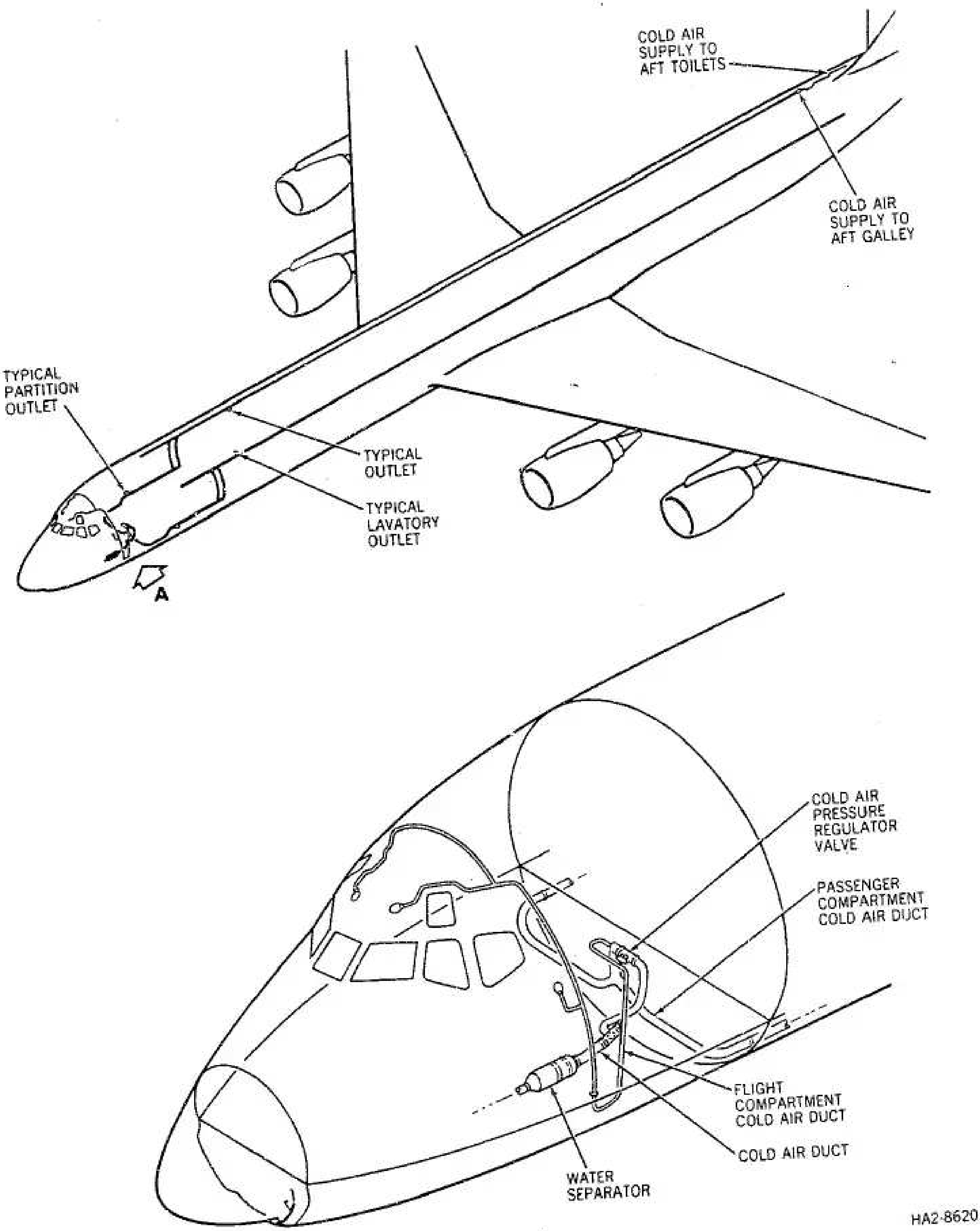

VIEW A

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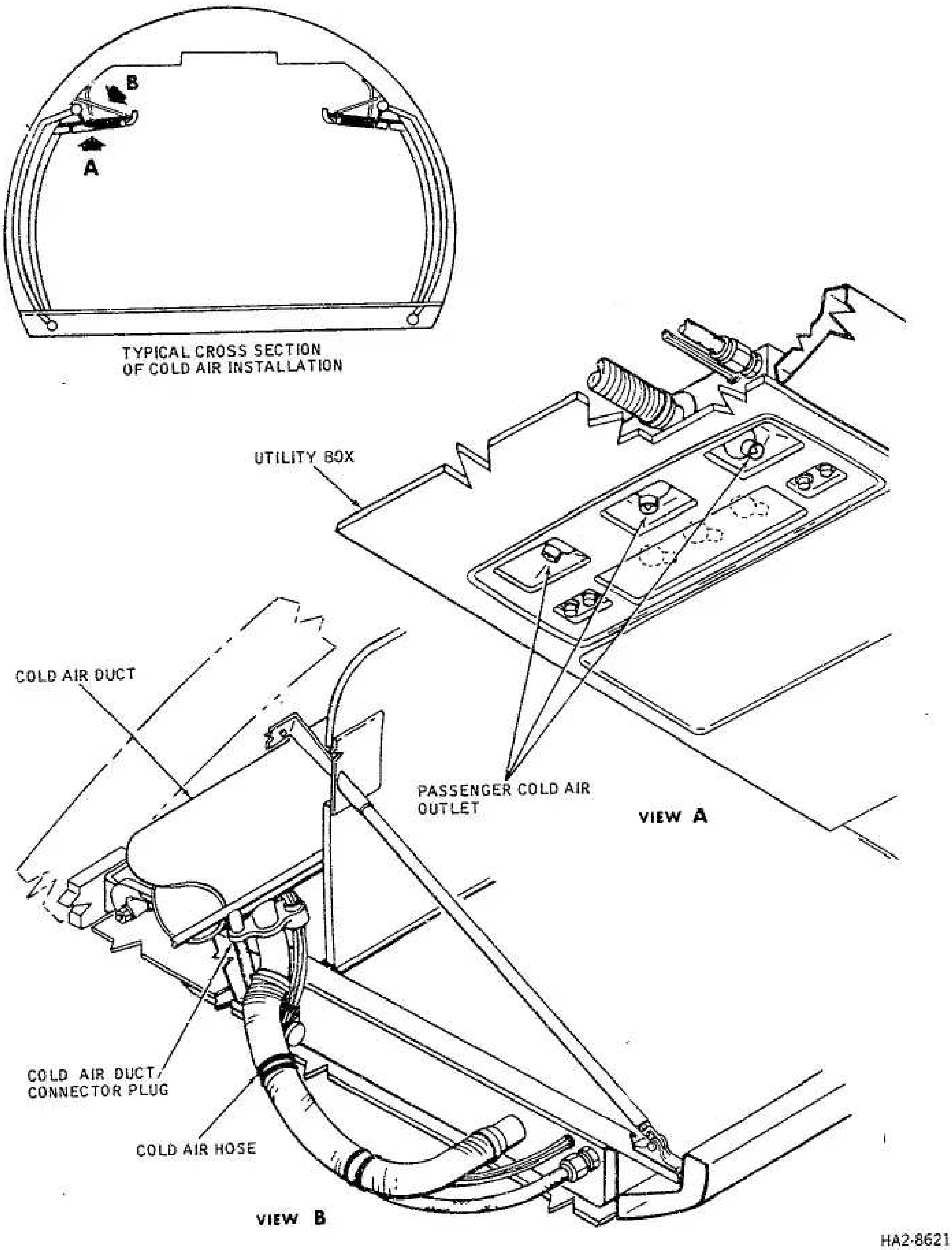
B
A
TYPICAL CROSS SECTION
OF COLD AIR INSTALLATION
UTILITY BOX
COLD AIR DUCT
PASSENGER COLD AIR
OUTLET
VIEW A
COLD AIR DUCT
CONNECTOR PLUG
COLD AIR HOSE
VIEW B
HA2-8621

generally along the airplane centerline the full length of the pasenger compartment, terminating at an overhead diffuser. Supply ducts branch off the main distribution duct and are routed down the sidewalls to plenum chambers located in the radiant panels at floor level. The radiant panels in the passenger compartment area vary in length from approximately 80 to 160 inches. These panels form the cabin interior sidewalls from the floor to the overhead stowage rack. Each panel consists of two thin sheets of plywood, which are separated by wood supporting strips. The strips are approximately 1/4 inch square, and are placed vertically 2 1/2-inches apart, below and between the windows. Above the windows, the strips are approximately 20 inches apart. Both ends and the bottom of each panel are closed, but a continuous opening is provided at the top for distribution of air.

F. Emergency Air Control Valve (See Figure 5.)

(1) In an emergency, ram air can be used for cabin ventilation. The emergency ram air ducting is connected from the left primary heat exchanger ram air plenum to the emergency ram air valve mounted on the left side of the pressure bulkhead in the air-conditioning accessory compartment. Emergency ram air outlet is routed to the main supply duct. The emergency air control valve is manually operated by a T-handle located in the flight compartment aft of the observer's seat.

G. Cold and Intermediate (Warm) Supply Check Valves (See Figure 6.)

(1) The cold and intermediate air supply check valves contain a free-swinging split leaf check valve that allows an unrestricted airflow in one direction and prevents airflow in the opposite direction. A cold air check valve is installed between the water separators and mixing valve in the cold air ducts of the left and right air conditioning systems. The intermediate air supply check valve is installed between the secondary heat exchanger and mixing valve of each system. The four valves are installed on the forward pressure bulkhead of the air-conditioning accessory compartment, and function to prevent loss of fuselage pressure if a duct leak occurs outside the pressurized area, or if one system is inoperative.

(2) Each valve consists of a valve body, valve seat, and split leaf check valve. The valve is hinged at the top of the valve body and is attached with screws to a flange welded to the valve seat. A silicone rubber seal is provided on the split leaf check valve.

H. Ground Conditioned Air Inlet Check Valve (See Figure 7.)

(1) The ground conditioned air inlet check valve contains a free-swinging flapper valve that allows airflow in one direction and prevents airflow in the opposite direction. The valve is part of the ground conditioned air inlet duct, which is installed in the air-conditioning accessory

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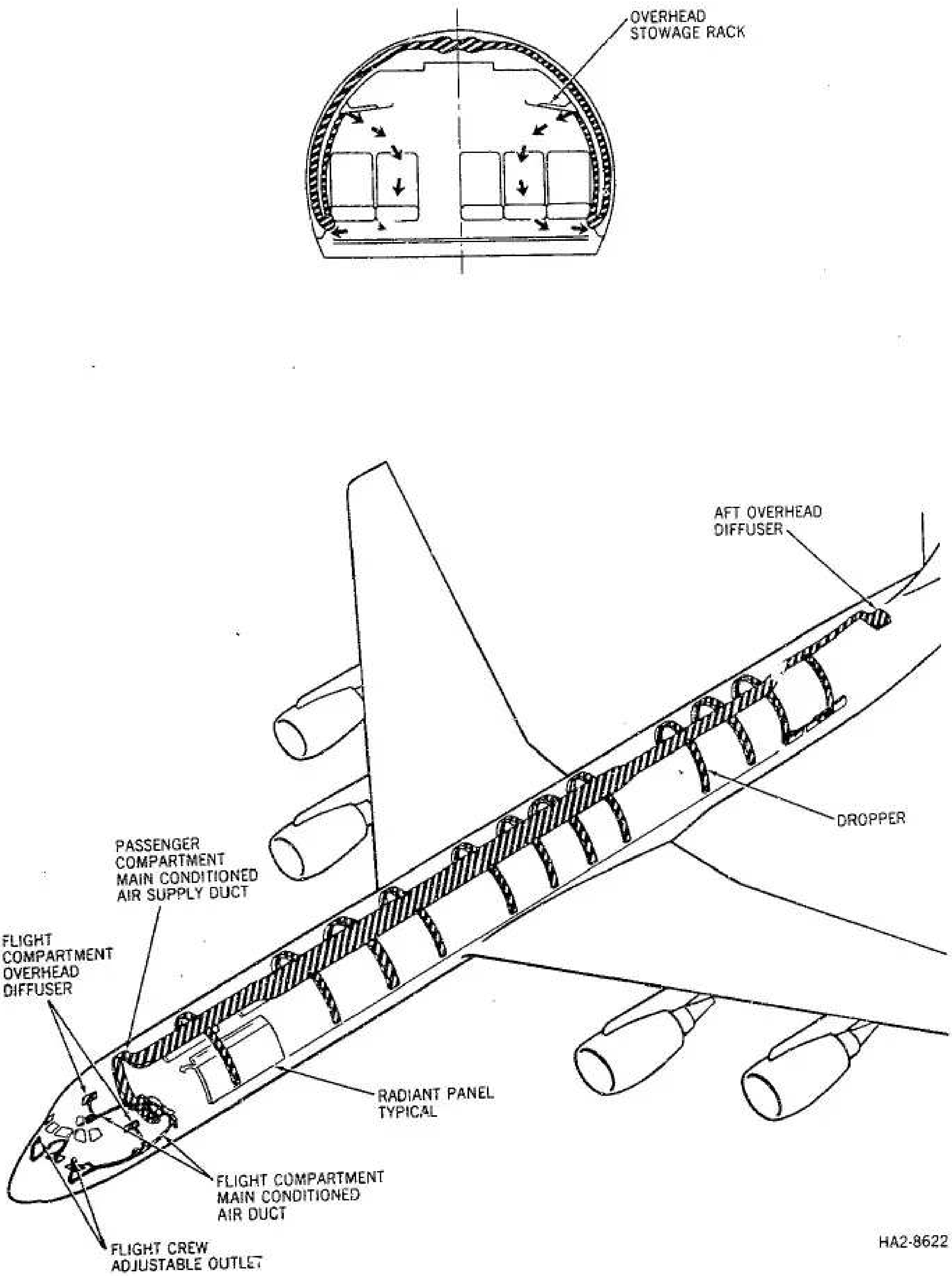

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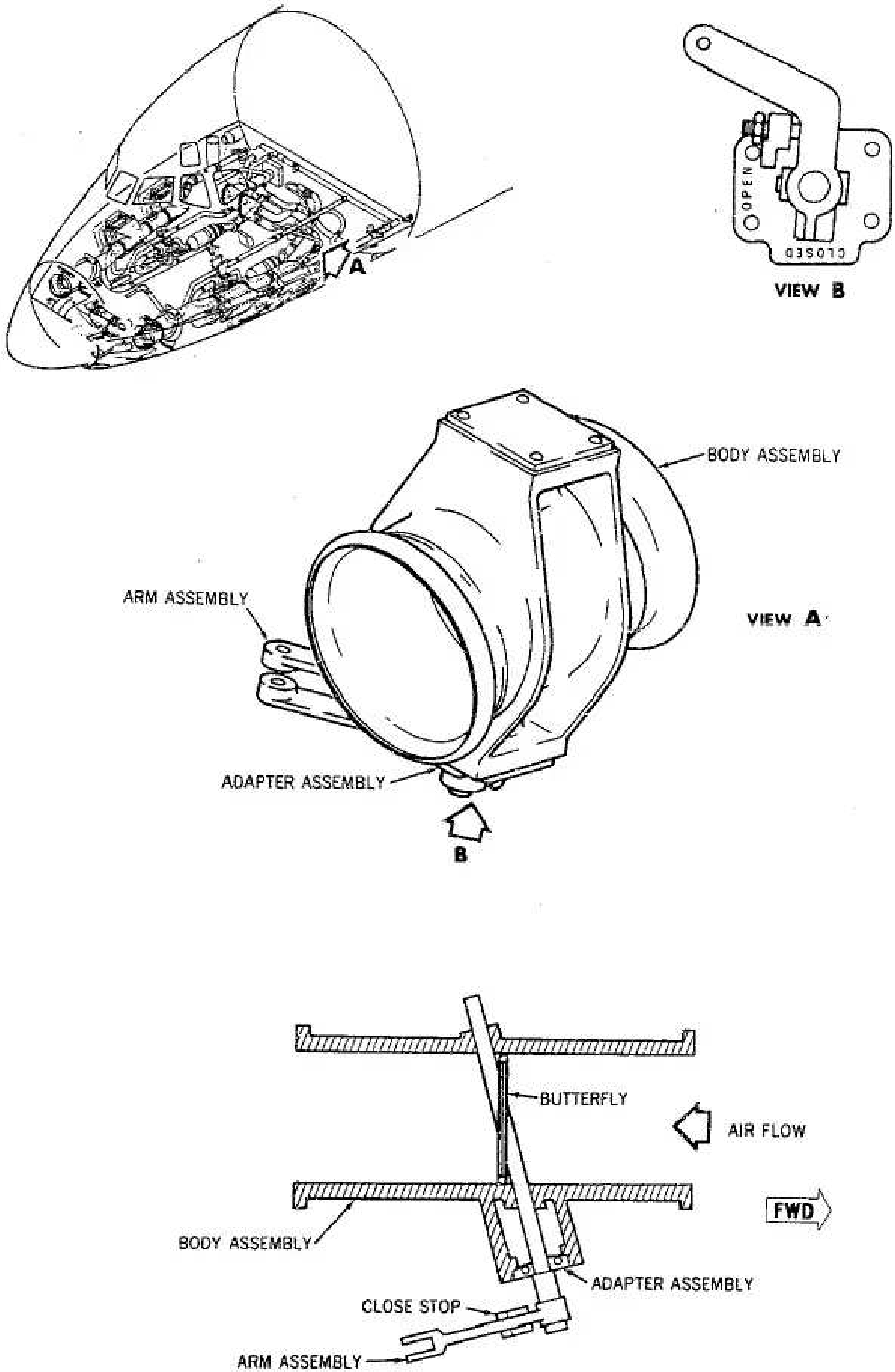

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Figure 5

TOC

compartment, and is connected to the passenger compartment main distribution ducts. The external access door is located on the right side of the nose section. A switch is installed in the duct assembly and is actuated when the flapper valve is fully open. The switch deenergizes the power relay in the recirculation fan motor circuit when ground conditioned air is being delivered at a pressure of approximately 10 inches of water.

I. Cold Air Pressure Regulator Valve (See Figure 8.)

(1) The cold air pressure regulator valve is a normally open, pneumatically actuated, differential control, butterfly-type valve. The valve reduces cold air supply pressure and is installed in the cold air main supply duct in the air-conditioning accessory compartment.

(2) The butterfly valve is normally spring loaded open while cold air pressure downstream of the valve is below 10 ±2 inches of water. As downstream pressure increases, the differentiator diaphragm spring force is overcome and the pilot valve is opened. Filtered pneumatic air enters the closing chamber, overcomes actuator spring force, and moves the butterfly valve toward the closed position. Cold air supply pressure is reduced; therefore, pressure on the differentiator diaphragm is reduced. Spring force returns the differentiator diaphragm to normal, and the pilot valve closes to shut off pneumatic supply pressure. Pressure remaining in the closing chamber is released to ambient through the bleed orifice, maintaining the butterfly valve open until cold air overpressure repeats the operation.

J. Cold Air Pressure Relief Valve

(1) A cold air pressure relief valve is installed in each of the two legs of the Y-duct located downstream from the pressure regulator valve in the air-conditioning accessory compartment. The relief valves protect the cold air ducting from overpressurization if the cold air pressure regulator valve fails.

K. Aft Cargo Compartment Blower (See Figure 9).

(1) The aft cargo compartment blower is used to heat the aft cargo compartment by circulating air through the double skin floor of the compartment. The blower consists of a single stage, axial flow fan driven by a totally enclosed 3-phase, 115 volt electric motor that incorporates internal thermal protection switches. The thermal protectors open to deenergize the motor circuits when the motor temperature exceeds 302 (±9) °F (150 (±5) °C) and close when the motor case cools to a temperature below 197 (±18)°F (92 (±10)°C). Under normal circumstances, the thermal protectors should reset in approximately 10 minutes.

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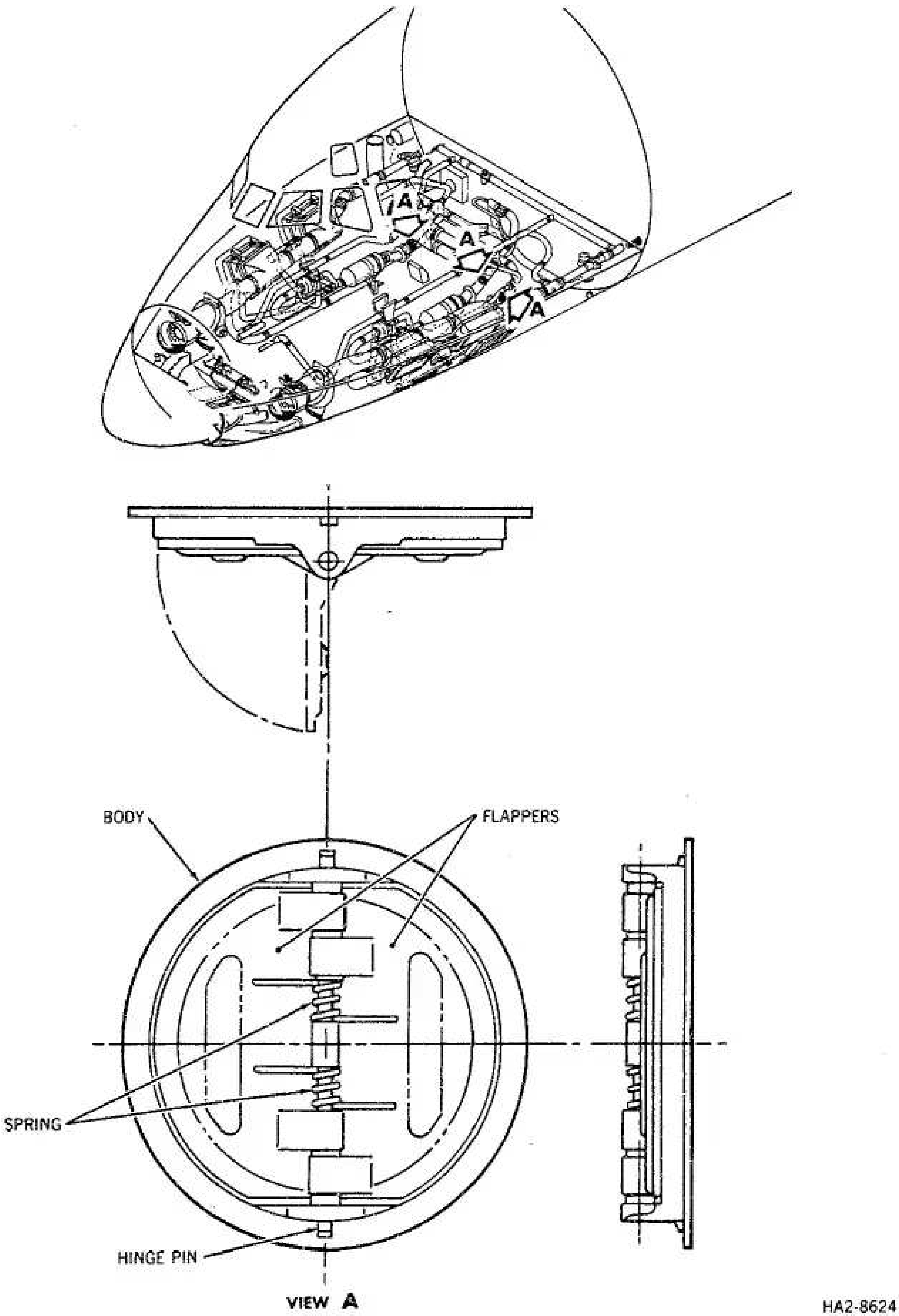

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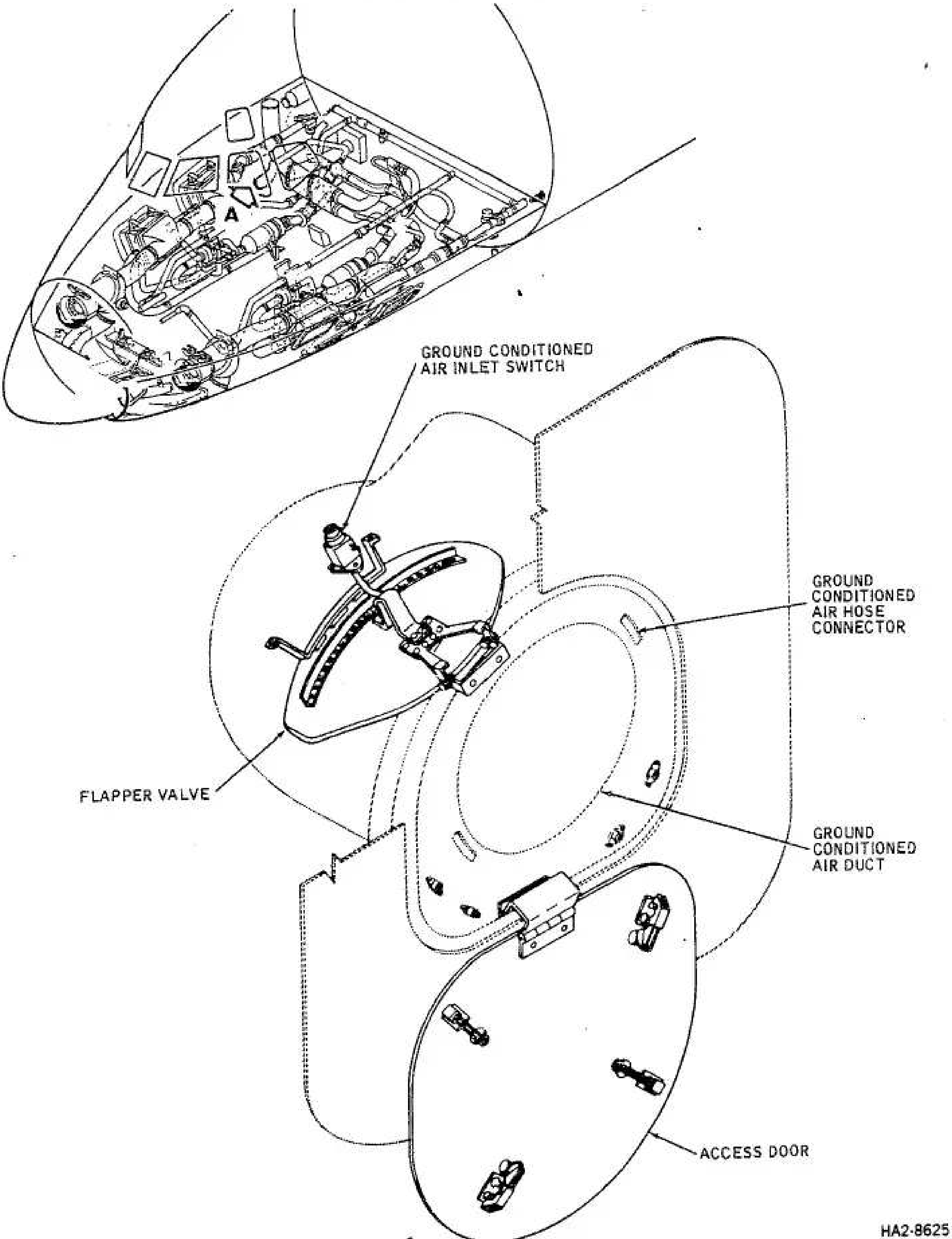

VIEW A

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(2) The aft cargo compartment blower is located in the forward end of the left utility tunnel adjacent to the aft cargo compartment. The fan is connected to ducts that direct blower airflow below the compartment floor and is mounted on vibration insulating supports. The blower operates continuously while the circuit breaker on the passenger compartment electrical panel is closed.

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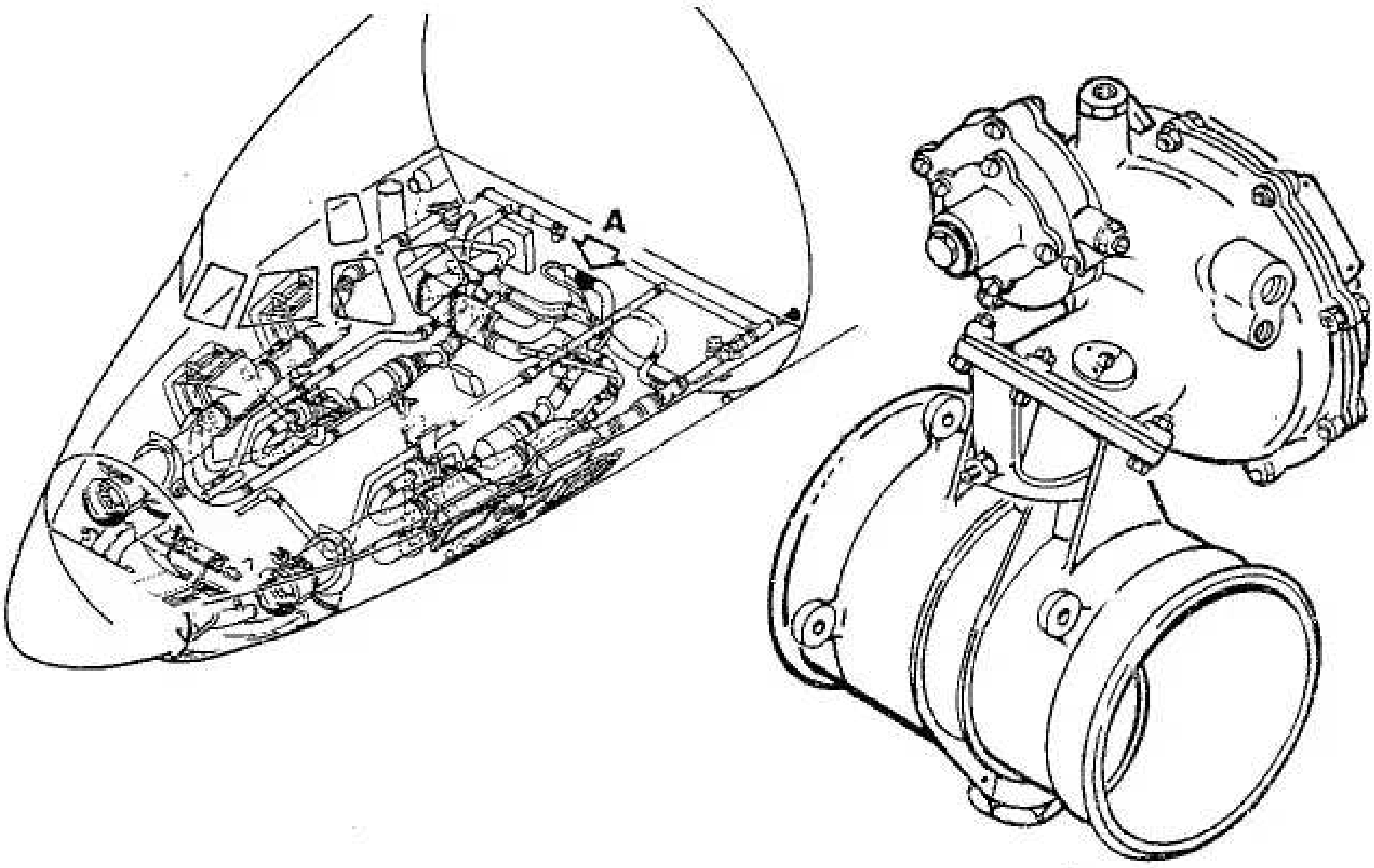

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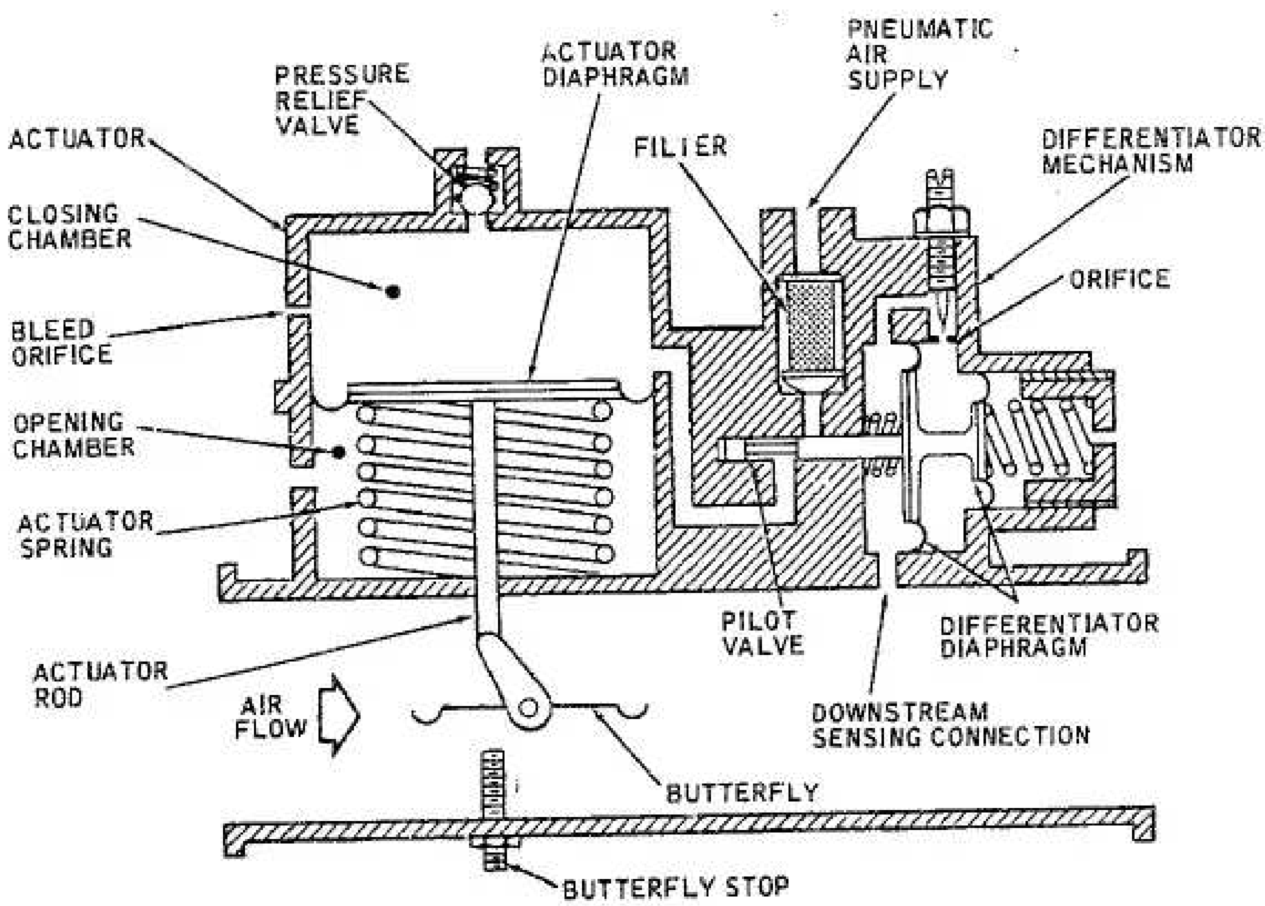

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3. System Operation (See Figure 10.)

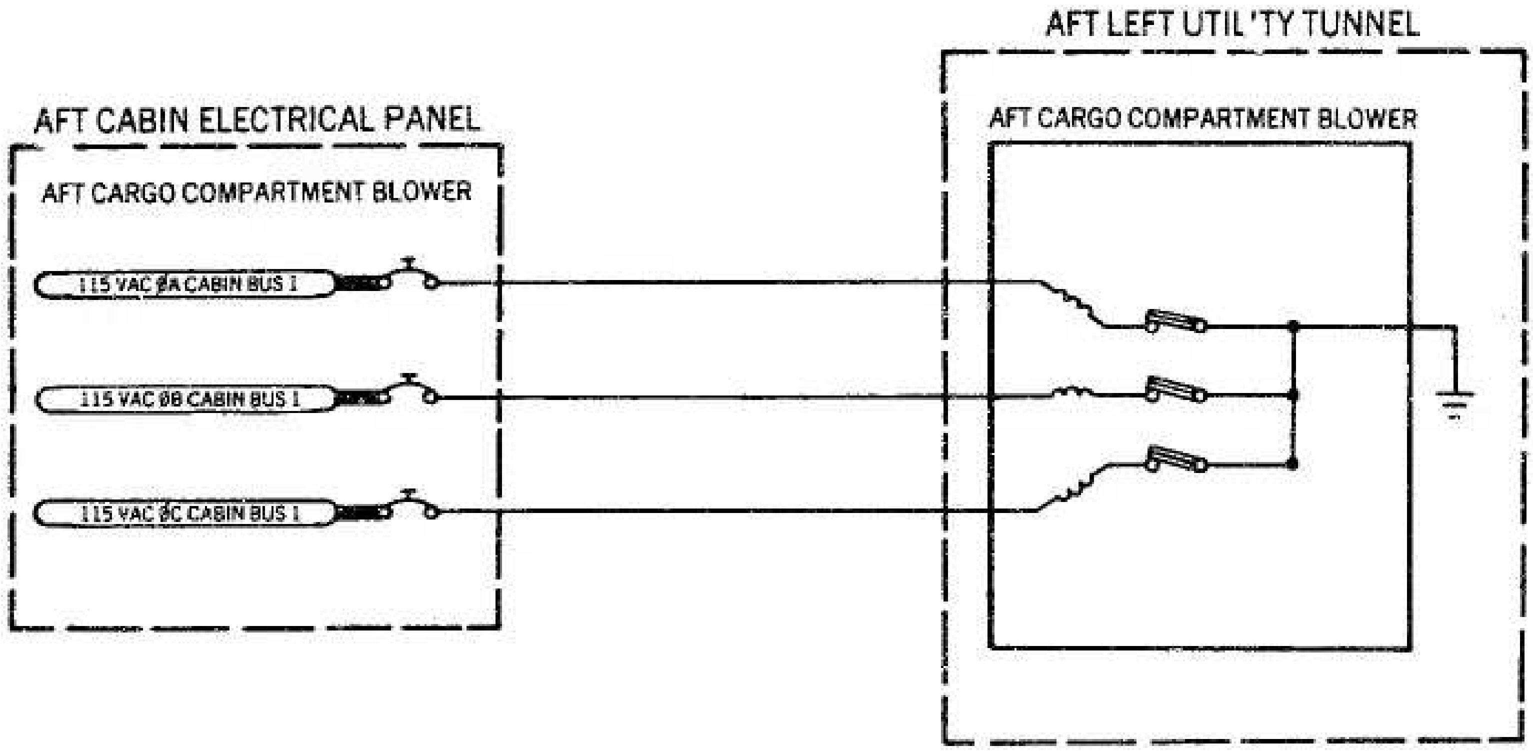
A. Ram Air

(1) The cooling system reduces the temperature of the engine bleed air output to whatever value is required to maintain a comfortable cabin temperature. The heat extracted from the cabin supply air during this process is rejected to cooling air which is taken in through the center ram air scoop in the nose of the airplane, passed through the heat exchangers, and then discharged overboard through louvered exits on
R the sides of the airplane. For ground operation, the cooling air for the heat exchangers is supplied by the pack ground cooling fan.

(2) In an emergency, ram air can be used for cabin ventilation. This air is supplied from the lefthand ram air scoop of the cabin cooling system through a manually actuated shutoff valve. This valve is manually operated by the T-handle located in the flight compartment aft of the observer's seat.

B. Hot, Warm, and Cold Air Supply

(1) The original source of fresh, hot, pressurized air delivered by the engine compressors is called the hot air supply. This air is routed through pack flow control/shutoff valves to the air-conditioning mixing valve hot air port and to inlet headers on the heat exchangers.



Aft Cargo Compartment Blower --

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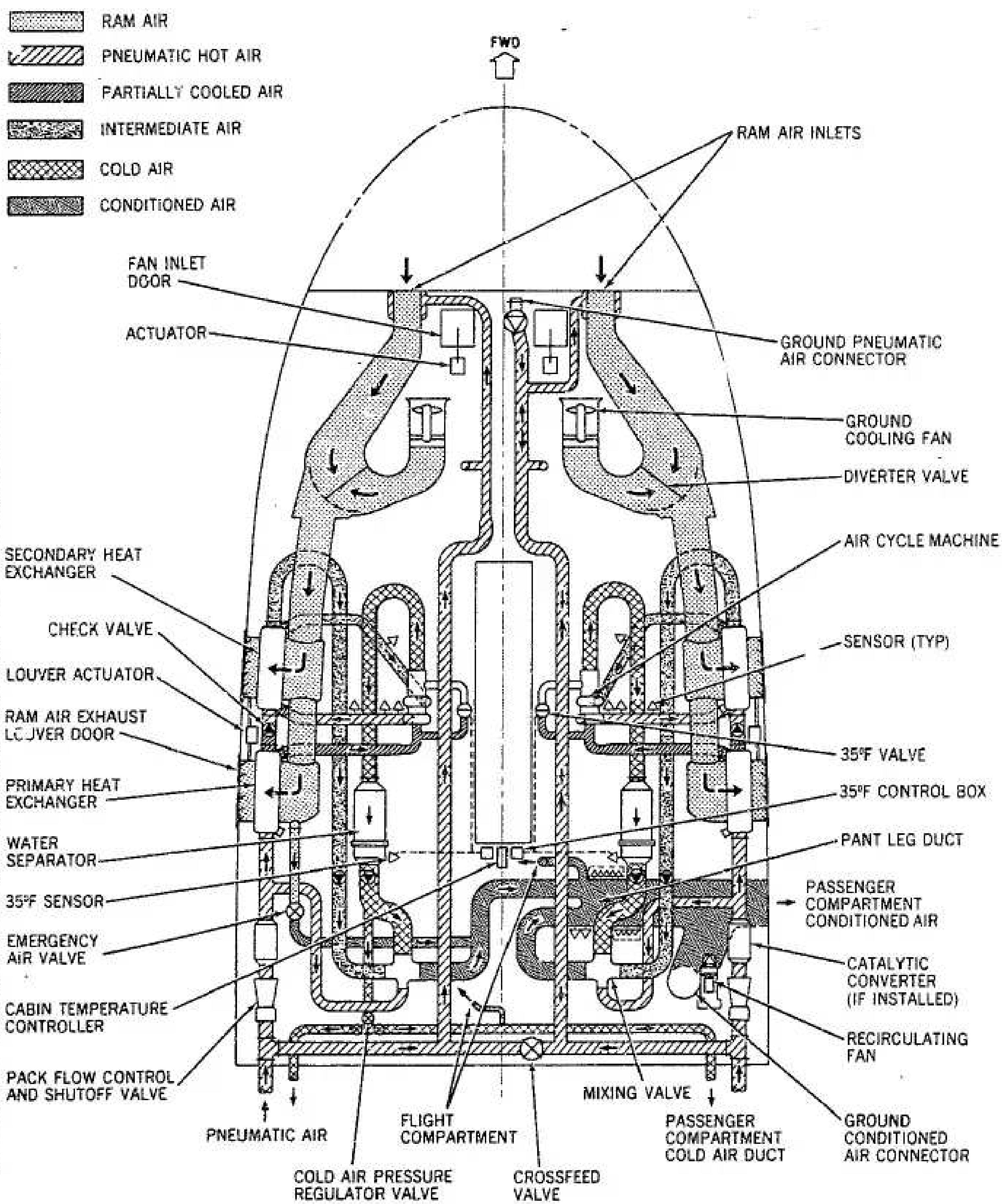

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The temperature of the hot air is reduced in the ram-air-cooled heat exchangers to form the warm air supply. Warm air is routed through a check valve to the mixing valve warm air port. Warm air also flows to the inlet of the air cycle machine turbine, which reduces the temperature further and forms the cold air supply. Cold air is routed through the water separator to the mixing valve cold air port, and through a takeoff duct from the left water separator outlet to the cold air distribution system.

C. Cold Air Distribution

(1) The normal source of cold air for distribution to the passenger and flight compartment cold air outlet (eyeball) valves is from the left water separator through the cold air pressure regulator valve (see Figure 10). The pressure regulator valve, controls cold airflow at 10 (±2) inches of water pressure in the distribution ducts, and two pressure relief valves protect against overpressurization. Cold air is distributed throughout the airplane (see Figure 2) to flight crew outlets, individual passenger outlets (see Figure 3), and to lavatory and galley installations.

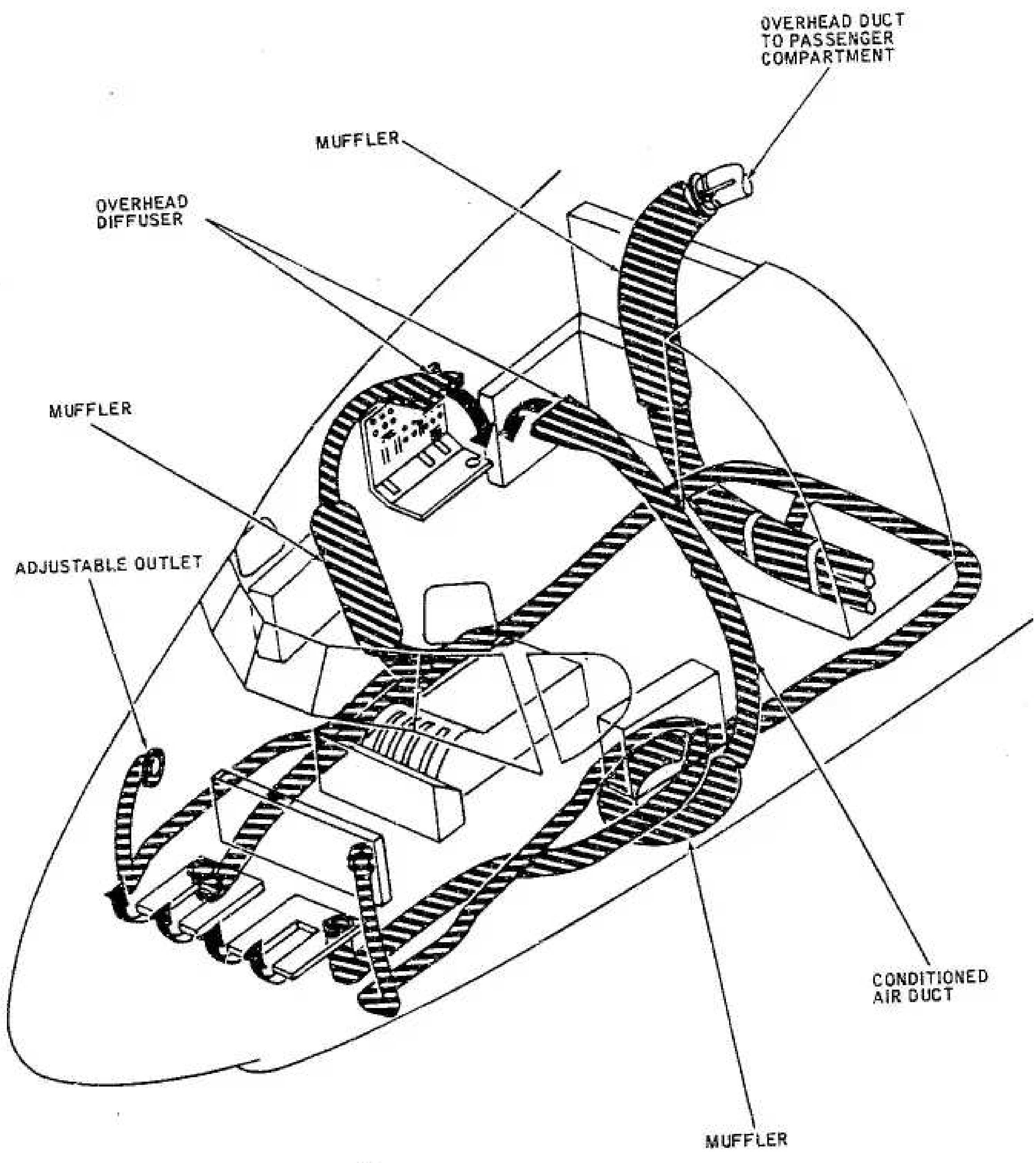
D. Conditioned Air Distribution

(1) Conditioned air source begins at the outlets of the left and right air-conditioning mixing valves in the air-conditioning accessory compartment (see Figure 10). Both supplies are directed into one large (pant leg) duct. At the outlet of the left air conditioning mixing valve, a duct is routed to the flight compartment distribution system. The remainder of the conditioned air from the left mixing valve, combined with conditioned air from the right mixing valve, is routed through the main duct and muffler to the aft overhead diffuser through the overhead ducting installations (see Figure 4). Droppers from the overhead ducting supply air to plenum chambers at the base of the radiant panels. Air flows upward, heating or cooling the panels, and is discharged through continuous openings above the windows and below the overhead stowage racks.

(2) Conditioned air is discharged into the flight compartment through two overhead diffusers and two floor outlets (see Figure 11), one at the captain's feet and one at the first officer's feet. Two adjustable outlets forward and outboard of the captain's and first officer's seats may also be installed for flight crew convenience. If the flight compartment (left) air conditioning system is inoperative, (see Figure 10) passenger compartment (right) conditioned air flows into the flight compartment distribution ducts.

E. Exhaust Air Provisions (See Figure 12.)

(1) Air exhausted from the flight compartment is drawn through the radio rack to cool the electrical and electronic equipment and is then used to heat the forward cargo compartment, or is discharged overboard depending on the mode of operation of the radio rack cooling system (see 21-53-0).



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Typical Flight Compartment Conditioned
Air Distribution

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When used to heat the cargo compartment, exhaust air is routed through the radio rack blower and between the floor of the forward cargo compartment and the outer skin insulation. Air passing below the cargo compartment floor is exhausted into the right utility tunnel under the passenger compartment floor. Some of the air flows forward to the recirculation fan. The balance flows aft through the accessories compartment over the wing into utility tunnels on each side of the aft cargo compartment. Part of the air passing into the left utility tunnel aft of the wing is drawn into the aft cargo compartment blower and is directed below the floor of the aft cargo compartment. From the utility tunnels, air flows overboard through the cabin air outflow valve.

(2) Conditioned air leaves the continuous outlets of the radiant panels below the overhead stowage racks (see Figure 4), flows downward toward the center aisle, and then outboard through grills below the side wall panels. From the exhaust grills, air flows through openings in the floor structure (cusp diaphragms) to the utility tunnels on each side of the cargo compartments (see Figure 12). No ventilation is provided in the cargo compartment.

(3) Discharging air from the lavatory and galley areas creates an airflow from the cabin to these areas to limit odor disposal to occupied sections. Air is exhausted from the galley area through overhead vents equipped with mufflers to dampen noise, through flow limiting nozzles, to overboard exhaust vents with an integral external shutoff feature. Air is exhausted from the lavatories through vents in the lavatory bowls and vents under the washstand. The vents under the washstands are equipped with mufflers to lower noise level. The vent ducts contain flow limiting nozzles and overboard exhaust vents.

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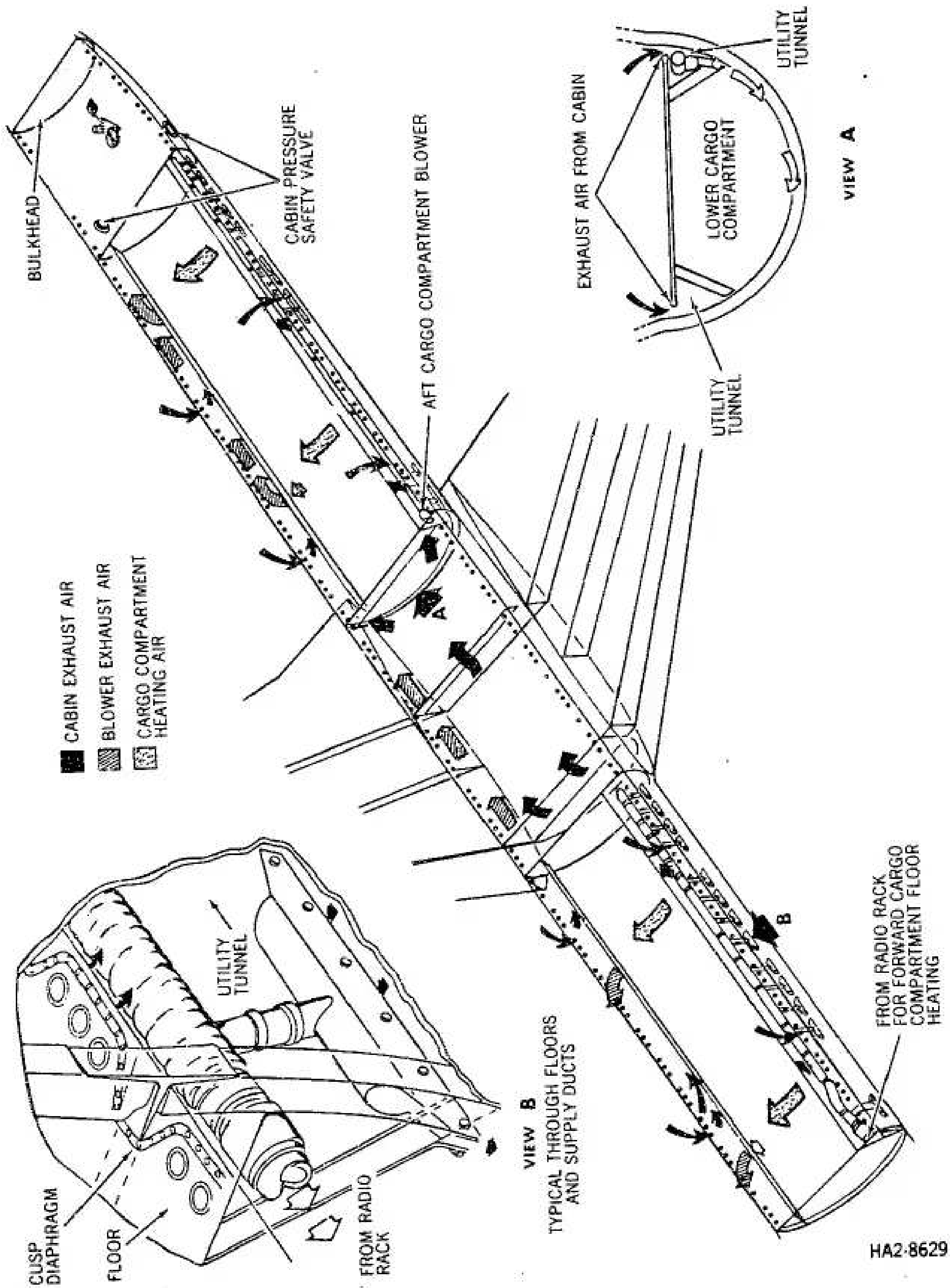

Cabin Exhaust Air Provisions
Figure 13

DISTRIBUTION SYSTEMS - MAINTENANCE PRACTICES

1. General

A. Cold air distribution system test procedures are presented for checking the functionability of the cold air pressure regulator valve and the cold air pressure relief valves regardless of system output or demands. In these test procedures a ground pneumatic source with controlled pressure is used. The conditioned air distribution test checks for airflow at all conditioned air outlets. A test is provided to check electrical circuits and power supply to the aft cargo compartment blower using the power phase sequence line checker.

2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Air gage of measuring pressure equal to 7 to 16 inches of water and accurate to ± 0.06 inch of water			Measure flow of cold air from cold air outlet valve
B	Air gage capable of measuring pressure equal to 0 to 3 inches of mercury in increments 0.1 inch			Measure pressure in cold air supply duct
C	Adapter			Install test gage in cold air outlet valve
D	Adapter			Install test gage in Y-duct fitting

Item	Name	Number	Manufacturer	Use
D	Power phase sequence line checker	4767455	Douglas Aircraft Co., Inc.	Perform electrical test of blower

3. Adjustment/Test Distribution Systems

A. Test Cold Air Distribution System

(1) Disconnect pressure sense line from cold air Y-duct in the air-conditioning accessory compartment (see 21-22-6) and seal sense line.

(2) Install air pressure gage to Y-duct sense line fitting.

(3) Close all individual cold air outlets.

(4) Position switches and controls as follows:

Control	Position
Left and right pack switches	Off
Low pressure pneumatic system switches	Off
Low-pressure pneumatic manifold crossfeed valve switch	Norm
Recirculating fan switch	Off
Left (cockpit) air-conditioning control	Automatic mode (mid position)
Temperature indicator selector switch	Cabin supply
Left pack flow selector	Maximum
Left cooling doors switch	Actuate for cooling doors indicator to full open

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(5) Pressurize airplane pneumatic manifold (see Chapter 36).

(6) Maintain 38 (±5) psig at 440°(±20)F (226.7°(±11.1)C) air supply at pneumatic manifold.

(7) Place left pack switch in on position.

(8) Determine by feel that pr ssure relief valves begin to open within the range of 1.3 to 2.6 inches of mercury gage.

NOTE: The definite opening point is distinctive as compared to normal leakage from valve.

(9) Place left pack switch to off position.

(10) Open all cold air outlets.

(11) Remove pressure gage from Y-duct fitting.

(12) Install pressure sense line to Y-duct fitting.

(13) Install adapter and test gage to an aft lavatory cold air outlet valve.

(14) Place left pack switch to on position.

(15) Check that airflow does not exceed pressure equal to 7.5 to 12.5 inches of water. Pressure should not fluctuate more than ±1 inc of water pressure when steady flow is achieved.

NOTE: A constant rapid pressure fluctuation may occur. A slower pressure control oscillation indicates an unsatisfactory pressure regulator.

(16) Place left pack switch in off position.

(17) Close all cold air outlets except 25 on each side at forward end of passenger compartment.

(18) Place left pack switch in on position.

(19) Check that airflow does not exceed pressure equal to 7.5 to 12.5 inches of water. Pressure should not fluctuate more that ±1 inch of water pressure when steady flow is achieved.

(20) Place left pack switch in off position.

(21) Remove pressure gage from cold air outlet valve.

(22) Depressurize pneumatic manifold (see Chapter 36).

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B. Test Conditioned Air Distribution System

(1) Close all cold air outlets.

(2) Place recirculating fan switch in on position.

(3) Check for airflow by feel at the following outlets:

(a) Captain's and first officer's foot floor panel outlets

(b) Adjustable conditioned air outlets in flight compartment

(c) Overhead outlets in flight compartment

(d) Overhead outlet in passenger compartment

(e) Passenger compartment sidewall strip outlets below baggage racks.

(4) Place recirculating fan switch in off position.

(5) Open cold air outlets.

C. Test Aft Cargo Compartment Heating Components Using Line Checker

(1) Open following circuit breakers:

Circuit Breaker	Circuit Breaker Panel
Aft cargo compartment blower phase A	Aft cabin
Aft cargo compartment blower phase B	Aft cabin
Aft cargo compartment blower phase C	Aft cabin

(2) Place line checker system selector switch to radio rack or aft cargo blower position (see Figure 201).

(3) Disconnect electrical connector from aft cargo compartment blower.

(4) Connect electrical connector to line checker radio rack or aft cargo blower receptacle.

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(5) Close following circuit breakers:

Circuit Breaker	Circuit Breaker Panel
Aft cargo compartment blower phase A	Aft cabin
Aft cargo compartment blower phase B	Aft cabin
Aft cargo compartment blower phase C	Aft cabin

(6) Check that three line voltage indicator lights and right ABC phase sequence indicator light comes on.

(7) Open following circuit breakers:

Circuit Breaker	Circuit Breaker Panel
Aft cargo compartment blower phase A	Aft cabin
Aft cargo compartment blower phase B	Aft cabin
Aft cargo compartment blower phase C	Aft cabin

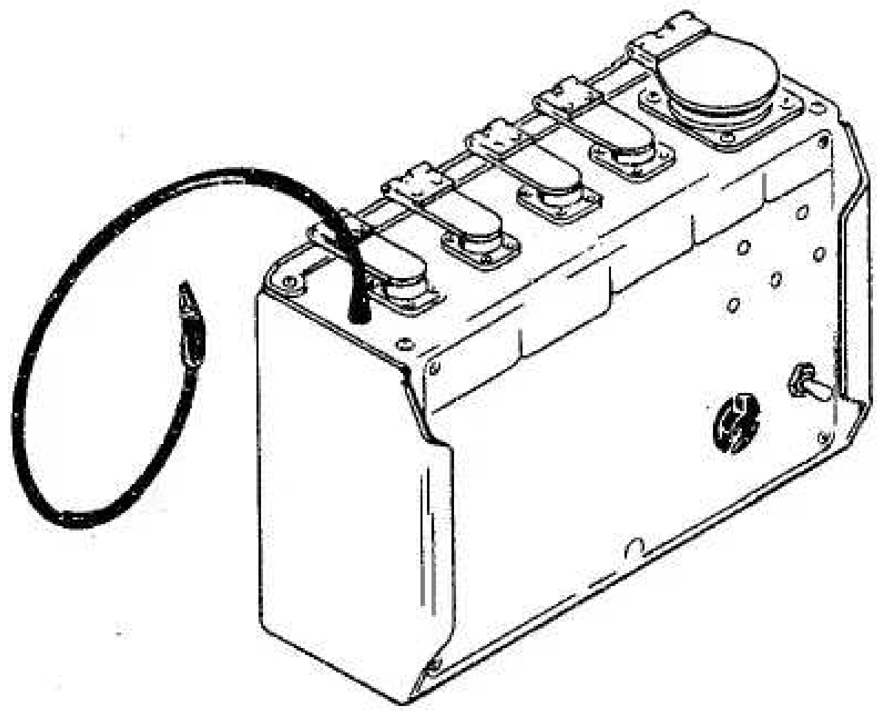
(8) Disconnect airplane electrical connector from line checker.

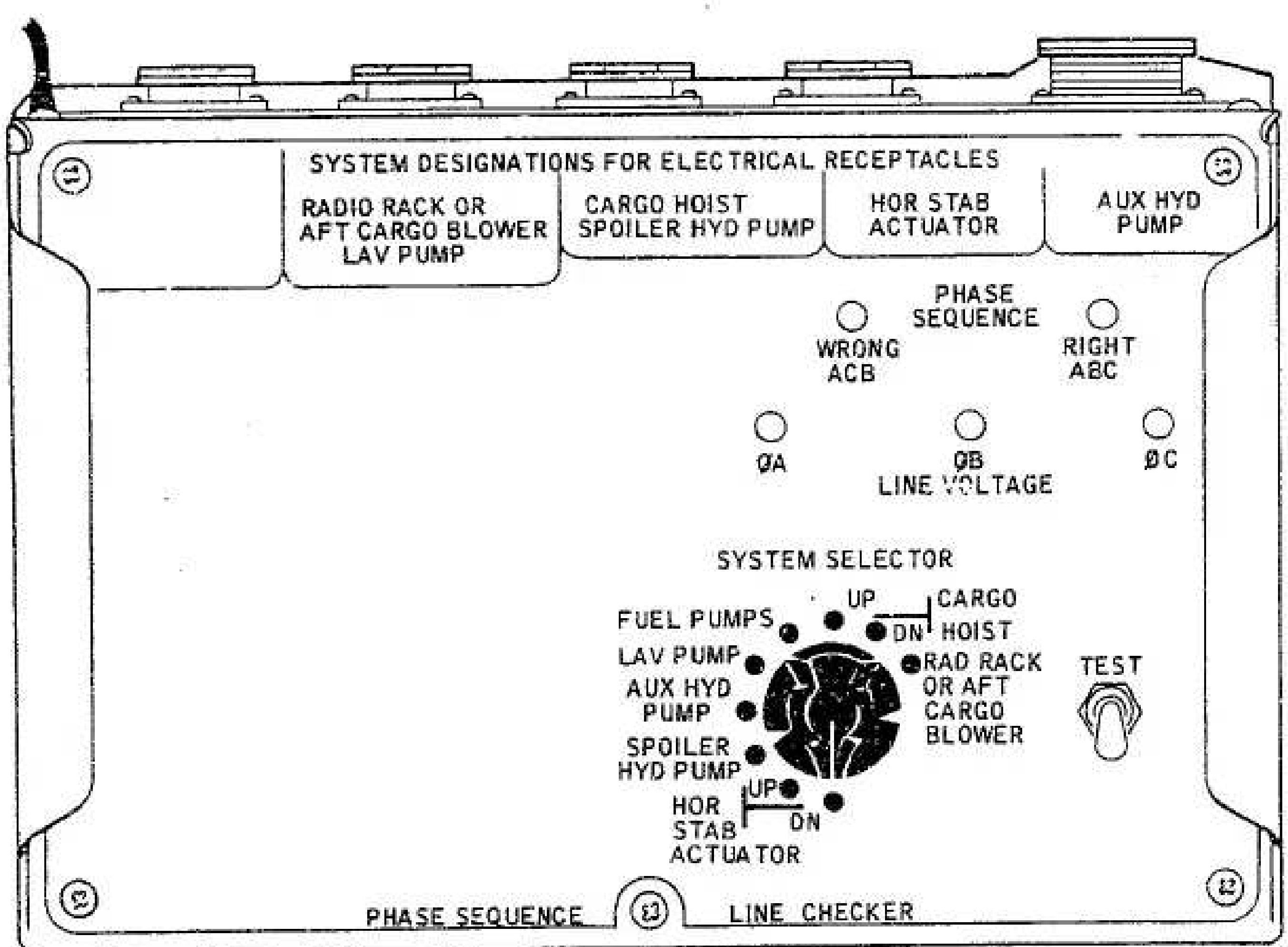
(9) Connect electrical connector to aft cargo compartment blower.

(10) Close following circuit breakers:

Circuit Breaker	Circuit Breaker Panel
Aft cargo compartment blower phase A	Aft cabin
Aft cargo compartment blower phase B	Aft cabin
Aft cargo compartment blower phase C	Aft cabin

TOC




SYSTEM DESIGNATIONS FOR ELECTRICAL RECEPTACLES
RADIO RACK OR AFT CARGO BLOWER LAV PUMP
CARGO HOIST SPOILER HYD PUMP
HOR STAB ACTUATOR
AUX HYD PUMP
PHASE SEQUENCE
WRONG ACB
RIGHT ABC
ØA
ØB
ØC
LINE VOLTAGE
SYSTEM SELECTOR
FUEL PUMPS
LAV PUMP
AUX HYD PUMP
SPOILER HYD PUMP
HOR STAB ACTUATOR
UP
DN
CARGO HOIST
RAD RACK OR AFT CARGO BLOWER
TEST
PHASE SEQUENCE
LINE CHECKER

HA2-8630

TOC

GROUND CONDITIONED AIR INLET CHECK VALVE AND SWITCH -

MAINTENANCE PRACTICES

1. General

   A. A single ground conditioned air inlet check valve is located between the passenger compartment main conditioned air duct in the air conditioning accessory compartment, and ground conditioned air access door pan installation in the right lower surface of the airplane skin. The ground conditioned air check valve switch is installed in the valve body.

   B. Access to the valve is through the air conditioning accessory compartment lower fuselage access door and the ground conditioned air access door.

   C. The switch installed in the valve is actuated by the flapper and deenergizes the power relay in the recirculating fan motor circuit, when ground conditioned air is being delivered at a pressure equal to approximately 10 inches of water.

2. Tools and Equipment Required

   NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Sealant	PR-1422	Products Research Co.	Seal check valve to pan installation
B	Sealant	EC-1608	Minnesota Mining & Manufacturing Co.	Seal switch to valve body
C	Trychloroethylene	MIL-T-7003		Prepare sealant surfaces on airplane and valve
D	Solvent	No. 14	Douglas Aircraft Co., Inc.	Remove sealant EC-1608 from switch
E	Plastic-bristle brush		Local	Remove sealant from airplane

3. Removal/Installation Ground Conditioned Air Inlet Check Valve and Switch

A. Remove Ground Conditioned Air Inlet Check Valve

(1) Open recirculating fan control circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Disconnect electrical connector from switch.

(3) Loosen connector clamps and slide connector clear of valve body.

(4) Remove row of screws which secure valve body flange to pan.

(5) Remove valve body from pan.

(6) Remove switch from valve body, if valve body is being replaced (see paragraph C).

B. Install Ground Conditioned Air Inlet Check Valve

(1) Make certain that recirculating fan control circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel is open.

(2) Remove old sealant from valve body and pan with solvent.

(3) Install switch if removed (see paragraph D).

(4) Apply sealant (PR-1422) to faying surfaces of valve body and pan.

(5) Install valve body to pan.

(6) Apply a fillet of sealant (PR-1422) around valve body flange.

(7) Install connector and clamps. Tighten clamps fingertight plus 1/2 turn.

(8) Connect electrical connector to switch.

(9) Close recirculating fan control circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(10) Test valve and switch (see paragraph 4).

(11) Leak check valve and switch installation (see paragraph 5).

C. Remove Ground Conditioned Air Check Valve Switch

(1) Open recirculating fan control circuit breaker located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker panel.

(2) Disconnect Electrical connector from switch.

(3) Remove switch.

D. Install Ground Conditioned Air Check Valve Switch

(1) Make certain that recirculating fan control circuit breaker located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker panel is open.

(2) Remove old sealant from switch installation with solvent.

(3) Apply sealant (EC-1608) to faying surface of switch and valve body.

(4) Position switch so that switch is open when flapper is seated against flapper stop, and install screws.

(5) Connect electrical connector.

(6) Close recirculating fan control circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(7) Test valve and switch (see paragraph 4).

(8) Leak check switch installation (see paragraph 5).

(9) Perform cabin pressure decay test (see 21-00, Maintenance Practices).

4. <u>Adjustment/Test Ground Conditioned Air Inlet Check Valve and Switch</u>

A. Test Ground Conditioned Air Inlet Check Valve and Switch

<u>NOTE</u>: The recirculating fan operates continuously when the airplane electrical buses are energized and the fan switch is in up (on) position.

(1) Open ground conditioned air access door.

(2) Manually move check valve flapper to full open position. Check that recirculating fan stops.

(3) Allow flapper to close. Check that recirculating fan starts.

(4) Connect ground source of conditioned air to connector. Check that recirculating fan stops when a pressure equal to approximately 10 inches of water is applied to the airplane conditioned air connector.

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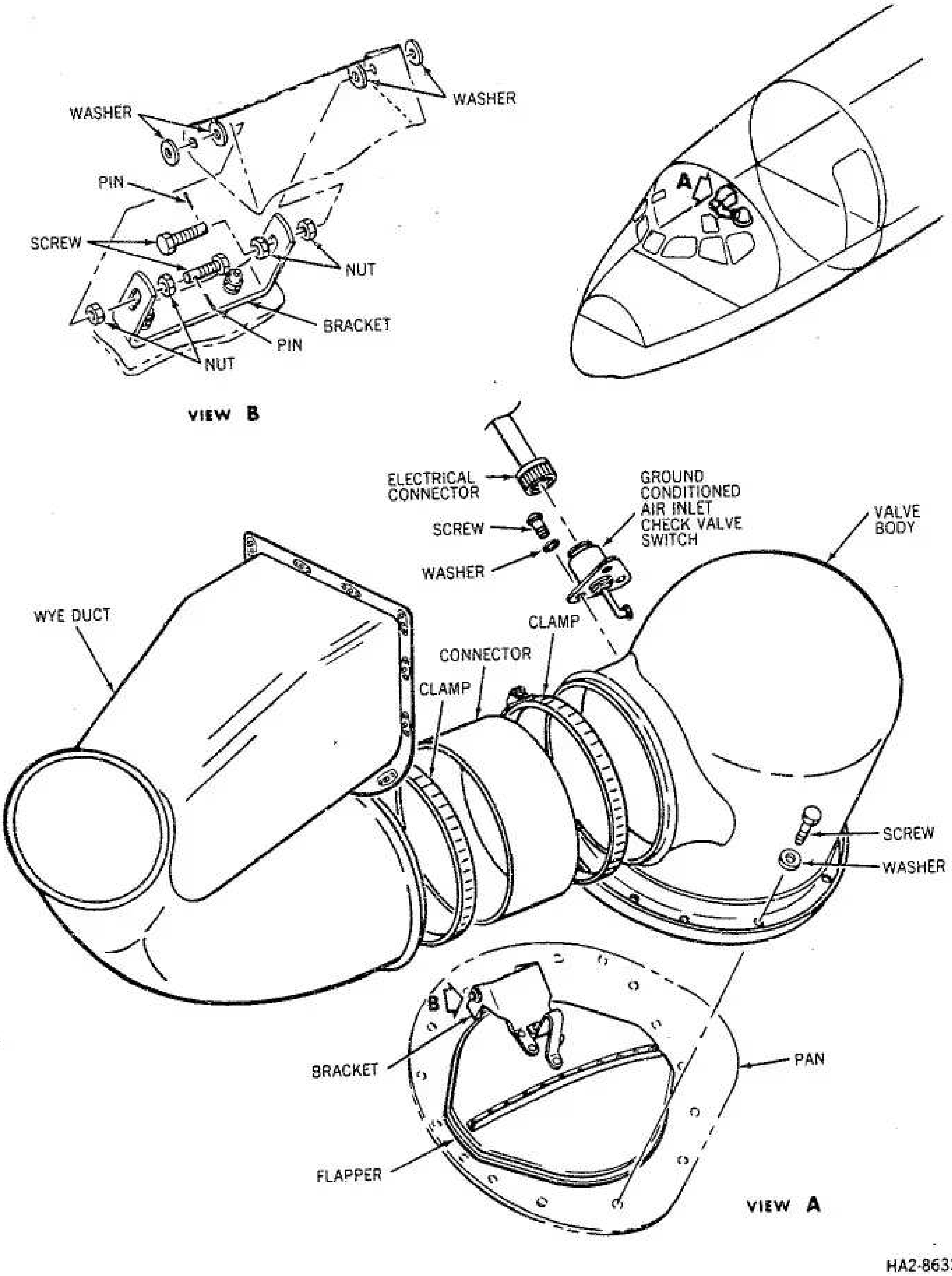
WASHER
WASHER
PIN
SCREW
NUT
BRACKET
PIN
NUT
VIEW B
A
ELECTRICAL CONNECTOR
SCREW
WASHER
GROUND CONDITIONED AIR INLET CHECK VALVE SWITCH
VALVE BODY
WYE DUCT
CLAMP
CONNECTOR
CLAMP
SCREW
WASHER
B
BRACKET
PAN
FLAPPER
VIEW A
HA2-8633

TOC

(5) Disconnect ground source of conditioned air.

(6) Close access door.

(7) Perform cabin pressure decay test (see 21-00, Maintenance Practices).

5. <u>Inspection/Check Ground Conditioned Air Inlet Check Valve and Switch</u>

A. Leak Check Ground Conditioned Air Inlet Check Valve and Switch

(1) Start air conditioning system (see 21-00, Description and Operation).

(2) Check connections of valve and switch for leaks by sound and feel.

(3) Open ground conditioned air access door.

(4) Check flapper for leaks by sound and feel.

(5) Stop air conditioning system.

(6) Close access door.

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DOUGLAS AIRCRAFT CO., INC.
DC-8 SEVENTY SERIES
MAINTENANCE MANUAL

COLD AIR PRESSURE REGULATOR VALVE - MAINTENANCE PRACTICES

1. General

A. A single cold air pressure regulator valve is located in the cold air supply duct between the col: air bypass valve and the Y-duct in the air conditioning accessory compartment.

B. Access to the valve is through the air conditioning accessory compartment lower fuselage access door.

C. The cold air pressure regulator valve test checks the ability of the regulator valve to maintain a constant pressure output regardless of system output or demands.

2. Tools and Equipment Required

Item	Name	Number	Manufacturer	Use
A	Air gage capable of measuring pressure equal to 7 to 16 inches of water and accurate to ±0.6 inch of water			Measuring flow of cold air from cold air outlet valve
B	Adapter			Installing test gage in cold air outlet valve

3. Removal/Installation Cold Air Pressure Regulator Valve

A. Remove Cold Air Pressure Regulator Valve

(1) Remove duct connected to cold air port of left air conditioning mixing valve.

(2) Disconnect pneumatic pressure line from pressure regulator valve actuator.

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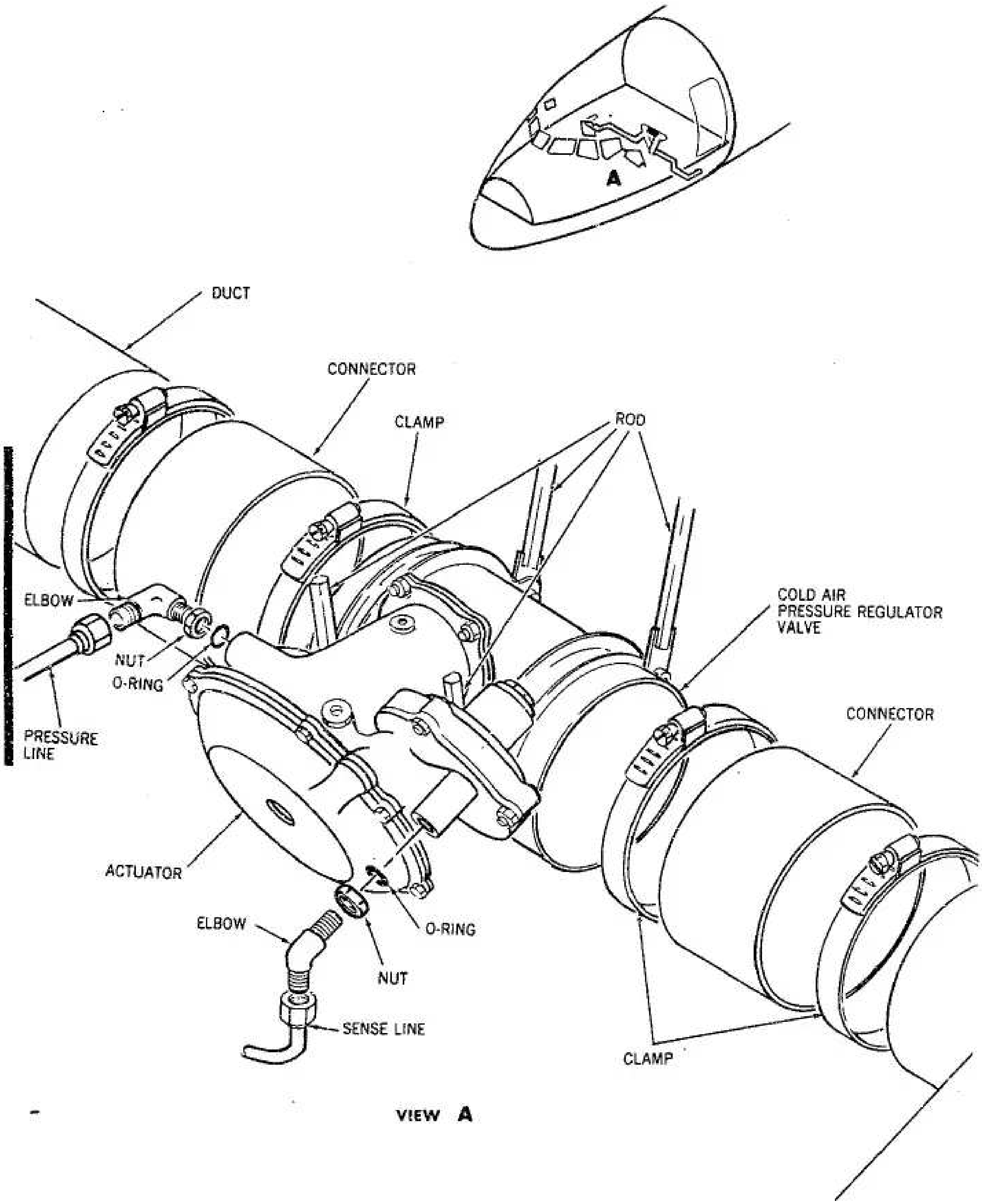

HA2-8634B

Cold Air Pressure Regulator Valve

TOC

(3) Disconnect sense line from pressure regulator actuator.

(4) Loosen connector clamps and slide connectors back to clear valve.

(5) Remove screws and washers from valve and support bracket.

(6) Remove valve.

B. Install Cold Air Pressure Regulator Valve

(1) Position valve and loosely install screws and washers through valve and support bracket.

(2) Slide connectors on valve, and tighten connector clamps fingertight plus 1/2 turn.

(3) Tighten support bracket screws.

(4) Connect sense line to actuator.

(5) Connect pressure line to actuator.

(6) Install duct to cold air port of left air conditioning mixing valve.

(7) Test cold air pressure regulator valve (see paragraph 4).

(8) Leak check cold air pressure regulator valve (see paragraph 5).

4. <u>Adjustment/Test Cold Air Pressure Regulator Valve</u>

A. Test Cold Air Pressure Regulator Valve

(1) Open all cold air outlets.

(2) Install adapter and test gage to an aft lavatory cold air outlet valve.

(3) Position switches and controls as follows:

Control	Position
Left pack switch	Off
Right pack switch	Off
Recirculating fan switch	Off
Pneumatic X-feed switch	Norm

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Control	Position
Cabin air outflow valve manual control and indicating lever	Automatic mode (unlocked position)

NOTE: The cabin pressure control system is in automatic mode when the cabin air outflow valve manual control and indicating lever knob is parallel with the control quadrant. The cabin pressure system is in manual mode when the manual control and indicating lever knob is extended and turned 90 degrees, allowing the lever to be locked in any position over the operating range.

(4) Pressurize airplane pneumatic manifold (see Chapter 36).

(5) Maintain 38 (±5) psig at 440°(±20)F (226.7°(±11.1)C) air supply at pneumatic manifold.

(6) Place left pack switch in on position.

(7) Check that airflow does not exceed pressure equal to 7.5 to 12.5 inches of water. Pressure should not fluctuate more than ±1 inch of water pressure when steady flow is achieved.

(8) Place left pack switch in off position.

(9) Close all cold air outlets, except 25 outlets on each side at forward end of passenger compartment.

(10) Place left pack switch in on position.

(11) Check that airflow does not exceed pressure equal to 7.5 to 12.5 inches of water. Pressure should not fluctuate more than ±1 inch of water pressure when steady flow is achieved.

(12) Place left pack switch in off position.

(13) Remove test gage from cold air outlet valve.

5. Inspection/Check Cold Air Pressure Regulator Valve

A. Leak Check Cold Air Pressure Regulator Valve

(1) Start air conditioning system (see 21-00, Description and Operation).

(2) Check connections at pressure regulator valve for leaks by sound and feel.

(3) Stop air conditioning system.

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COLD AIR PRESSURE RELIEF VALVE - MAINTENANCE PRACTICES

1. General.

   A. Two cold air pressure relief valves are located downstream of the Y-duct in the main cold air distri ution supply, in the air conditioning accessory compartment.

   B. Access to the valves is through the air conditioning accessory compartment lower fuselage access door.

   C. The cold air pressure regulator valve test checks ability of the pressure relief valves to relieve cold air distribution duct pressure within a range of 1.3 to 2.2 inches of mercury gage.

2. Tools and Equipment Required

Item	Name	Number	Manufacturer	Use
A	Air gage capable of measuring pressure equal to 0 to 3 inches of mercury in increments of 0.1 inch of mercury			Measure pressure in cold air supply duct
B	Adapter			Install test gage in wye duct fitting

3. Removal/Installation Cold Air Pressure Relief Valve

   A. Remove Cold Air Pressure Relief Valve

      (1) Loosen strap and remove half clamps.

      (2) Remove valve and seal. Discard seal if deteriorated.

   B. Install Cold Air Pressure Relief Valve

      (1) Position valve and seal. Ensure that seal covers bead on valve and duct.

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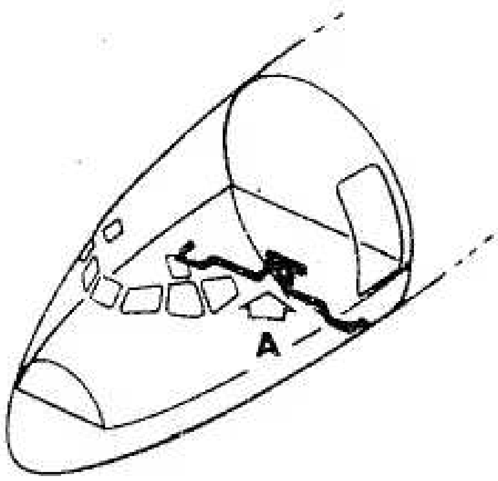

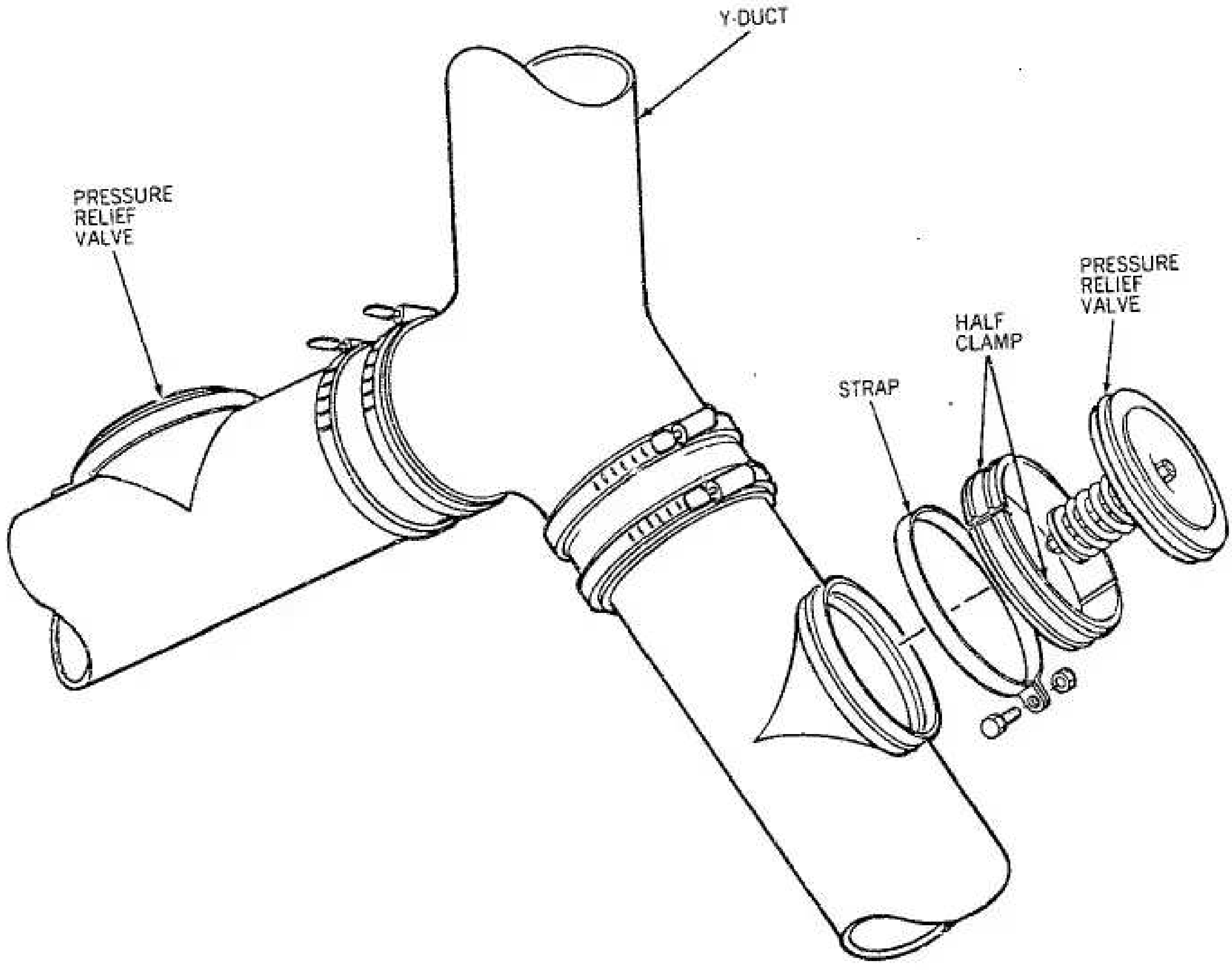

VIEW A

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DOUGLAS AIRCRAFT CO., INC.

DC-8 SEVENTY SERIES

MAINTENANCE MANUAL

(2) Install half clamps and strap. Tighten strap bolt to torque of 20 to 25 inch-pounds.

(3) Test cold air pressure relief valve (see paragraph 4).

(4) Leak check cold air pressure relief valve (see paragraph 5).

4. Adjustment/Test Cold Air Pressure Relief Valve

A. Test Cold Air Pressure Relief Valve

(1) Disconnect pressure sense line from Y-duct (see 21-22-5, Figure 201), and seal sense line.

(2) Install air pressure gage to Y-duct sense line fitting.

(3) Close all cold air outlets.

(4) Position switches and controls as follows:

Control	Position
Left pack switch	Off
Right pack switch	Off
Recirculating fan switch	Off
Pneumatic X-feed switch	Norm
Cabin air outflow valve manual control and indicating lever	Automatic mode (unlocked position)

NOTE: The cabin pressure control system is in automatic mode when the cabin air outflow valve manual control and indicating lever knob is parallel with the control quadrant. The cabin pressure system is in manual mode when the manual control and indicating lever knob is extended and turned 90 degrees, allowing the lever to be locked in any position over the operating range.

(5) Pressurize airplane pneumatic manifold (see Chapter 36).

(6) Maintain 38 (±5) psig at 440° (±20)°F (226.7° (±11.1)°C) air supply in pneumatic manifold.

(7) Place left pack switch in on position.

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(8) Determine by feel that pressure relief valves begins to open within the range of 1.0 to 1.4 inches of mercury gage.

NOTE: The definite opening point is distinctive as compared to normal leakage from valve.

R NOTE: System pressure is limited to approximately 1.4 inches of mercury with left pack only and no recirculating fan to 2.2 inches of mercury with both packs and recirculating fan running.

(9) Place left pack switch in off position.

(10) Depressurize pneumatic manifold (see Chapter 36).

(11) Open all cold air outlets.

(12) Remove pressure gage from Y-duct fitting.

(13) Install pressure sense line to Y-duct fitting.

5. Inspection/Check Cold Air Pressure Relief Valve

A. Leak Check Cold Air Pressure Relief Valve

(1) Start air conditioning system (see 21-00 Description and Operation).

(2) Check connections at pressure relief valve for leaks by sound and feel.

(3) Stop air conditioning system.

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EMERGENCY AIR CONTROL VALVE - MAINTENANCE PRACTICES

1. General

   A. Emergency ram air ducting is connected from the left primary heat exchanger ram air plenum to the emergency air control valve mounted on the left side of the pressure bulkhead ir the air-conditioning accessory compartment. Emergency ram air outlet is routed to the main supply duct. The emergency air control valve is manually operated by a T-handle located in the flight compartment aft of the observer's seat.

   B. Access to the emergency air control valve is through the air-conditioning accessory compartment lower fuselage access doors.

2. Removal/Installation Emergency Air Control Valve (See Figure 201)

   A. Remove Emergency Air Control Valve

      (1) Verify left and right pack switches are in the off position.

      (2) Remove pull cable from valve.

      (3) Loosen coupling clamp at each end of valve body and slide clamps onto connecting ducts. Remove valve.

   B. Install Emergency Air Control Valve

      (1) Make certain that left and right pack switches are in the off position.

      (2) Verify the cable T-handle is in the close position.

      (3) Install valve with V band couplings somewhat loose.

      (4) Install cable on valve with pin and install cotter pin.

      (5) Position tee handle 0.375 inch from full in.

      (6) Rotate valve body until valve arm is within 0.010 inch of the close stop.

      (7) Tighten V-band couplings to torque of 35 to 45 inch-pounds.

      NOTE: Maintain tee handle position to ensure correct adjustment.

      (8) Push tee handle to close and locked; valve should be closed as indicated by valve arm against close stop.

      (9) Rotate and then pull tee handle full out; valve should be fully open as indicated by valve lever at OPEN position.

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(10) Push tee handle to close and lock, the valve should close.

3. <u>Adjustment/Test Emergency Air Control Valve (See Figure 201)</u>

A. Test Valve

(1) Rotate and pull firmly on tee handle, located in flight compartment, full out; vent valve should open fully, as indicated by valve lever at open position.

(2) Push tee handle 0.375 inch from full in; verify valve arm is within 0.010 inch of the closed stop.

(3) Push tee handle full in and locked; valve should be fully closed as indicated by valve arm against closed stop.

B. Adjust Valve

(1) Loosen V-band coupling at each end of valve body.

(2) Position tee handle, located in flight compartment, to 0.375 inch from full in.

(3) Rotate valve body until valve arm is within 0.010 inch of the closed stop.

(4) Tighten V-band couplings to torque of 35 to 45 inch-pounds.

<u>NOTE</u>: Maintain tee handle position to insure correct adjustment.

(5) Pull firmly on tee handle full out; vent valve should open fully, as indicated by valve lever at open position.

(6) Push tee handle full in and locked; valve should be fully closed as indicated by valve arm against closed stop.

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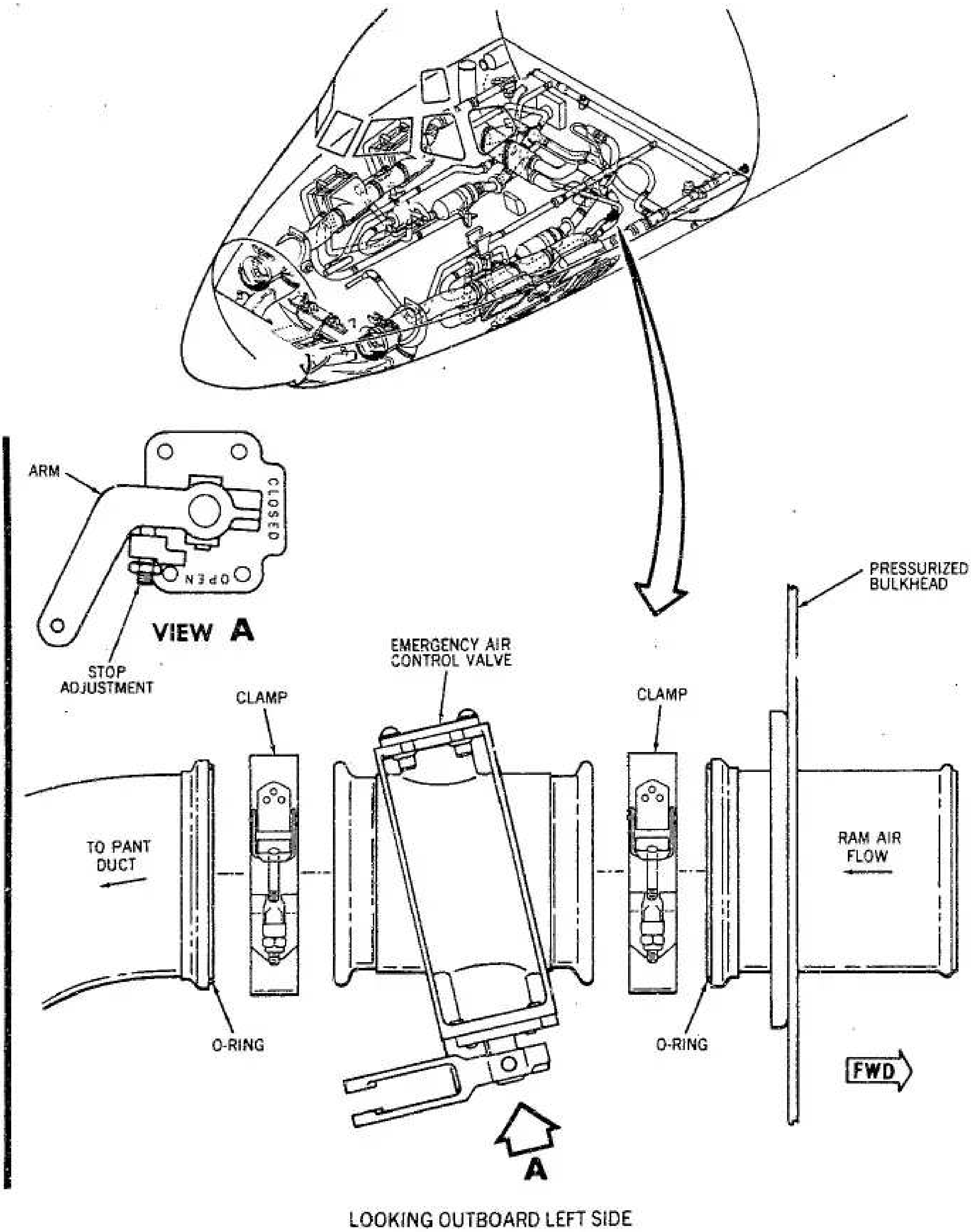

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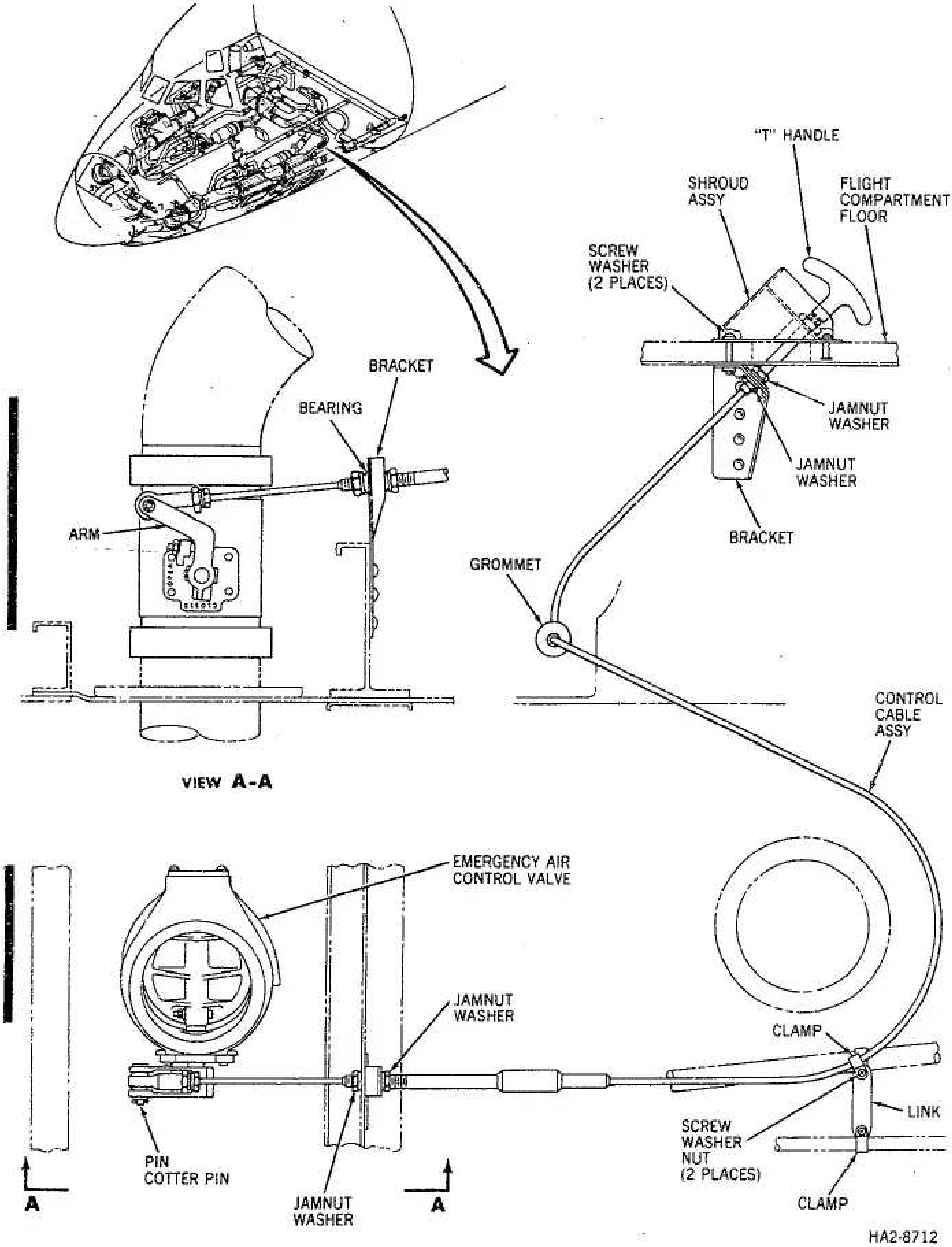
"T" HANDLE
SHROUD ASSY
FLIGHT COMPARTMENT FLOOR
SCREW WASHER (2 PLACES)
BRACKET
BEARING
JAMNUT WASHER
JAMNUT WASHER
ARM
BRACKET
GROMMET
VIEW A-A
CONTROL CABLE ASSY
EMERGENCY AIR CONTROL VALVE
JAMNUT WASHER
CLAMP
LINK
SCREW WASHER NUT (2 PLACES)
PIN COTTER PIN
JAMNUT WASHER
CLAMP
A
A
HA2-8712

COLD AND INTERMEDIATE AIR SUPPLY CHECK VALVE - MAINTENANCE PRACTICES

1. General

   A. Cold and intermediate air supply check valves for the left and right air conditioning systems are installed in the air conditioning accessory compartment on the forward pressure bulkhead. Windows located in the ducting to view flapper positions, are removable to allow bore scope entry for detail inspection of hinges and springs.

   B. Access to the valves is through the air conditioning accessory compartment.

   C. Removal and installation procedures for each valve in the right and left systems are identical except as noted.

2. Removal/Installation Cold and Intermediate Air Supply Check Valve

   A. Remove Air Supply Check Valve

      (1) Disconnect V-clamp from mating duct to mixing valve.

      (2) Remove bolts that secures check valve to mating ducts.

      (3) Remove valve and mixing valve duct.

   B. Install Air Supply Check Valve

      (1) Inspect duct flange O-rings, install check valve between mating ducts with V-clamp.

      (2) Install duct to mixing valve inlet. Tighten V-band couplings to torque of 50-70 inch-pounds.

      (3) Perform cabin pressure decay test (see 21-31-0, Maintenance Practices).

         NOTE: Use only air conditioning pack on side opposite valve being tested.

      (4) Leak check air supply check valve (see paragraph 3).

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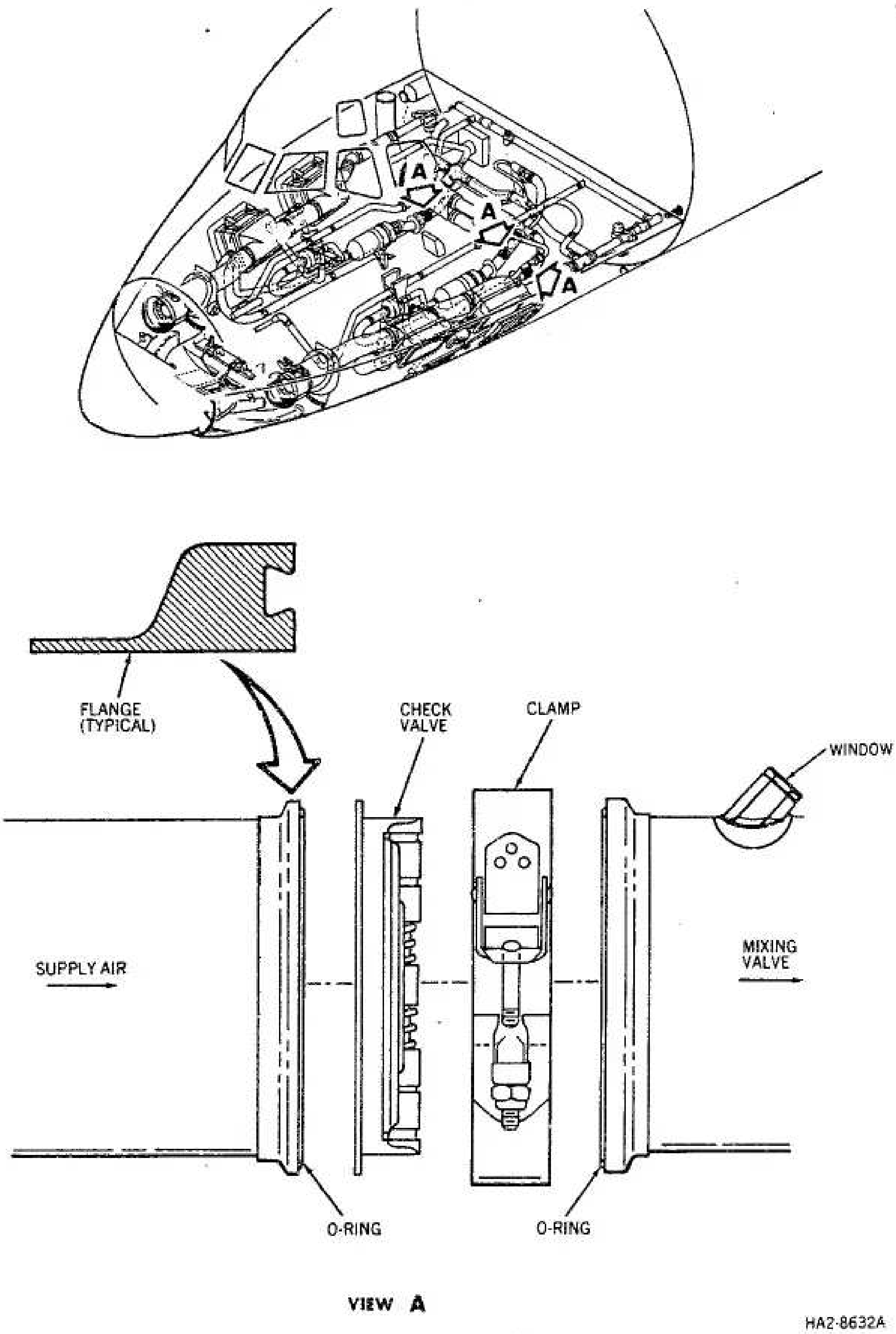
A
A
A
FLANGE (TYPICAL)
CHECK VALVE
CLAMP
WINDOW
SUPPLY AIR
MIXING VALVE
O-RING
O-RING
VIEW A
HA2-8632A

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3. Inspection/Check Cold and Intermediate Air Supply Check Valve

A. Leak Check Air Supply Check Valve

(1) Verify check valve is closed (sight through inspection window).

(2) Start corresponding air conditioning system (see 21-00, Description and Operation).

(3) Check all connections for leaks by sound and feel.

(4) Sight through check valve inspection window and verify valve operation.

(5) Stop air conditioning system.

(6) Verify check valve is closed.

PRESSURIZATION CONTROL - DESCRIPTION AND OPERATION

1. General

A. Cabin pressurization is obtained by releasing conditioned air under pressure into the sealed areas of the fuselage, and limiting the rate at which air is exhausted to the atmosphere. The purpose of the pressurization control system is to keep the occupied areas of the airplane as near sea level pressure as possible, except as limited by the maximum allowable cabin pressure differential. The pressurized areas of the airplane can be maintained at sea level pressure up to a flight altitude of 23,000 feet. When the airplane is above 23,000 feet, the cabin altitude must be raised above sea level to prevent exceeding the cabin pressure differential limit. The cabin altitude is changed at a slow controlled rate for passenger comfort during climb and descent. The maximum cabin altitude change is to a pressure altitude of 6700 feet while the airplane is at 40,000 feet. This imposes a cabin-to-atmosphere pressure differential of 8.77 psi. The pressurization control section consists of the cabin pressure control system and cabin pressure indication.

B. The major portion of the airplane fuselage is pressurized (see 21-00, Figure 1). The forward limit of the upper pressurized area is the bulkhead forward of the instrument panel. The forward limit of the lower pressurized area is the aft bulkhead of the nosewheel well. The aft limit of the pressurized area is the passenger compartment aft bulkhead. Pressurized bulkheads are built around the main landing gear well which is formed by the passenger compartment floor, the aft bulkhead of the forward cargo compartment, and the forward bulkhead of the aft cargo compartment.

C. The air conditioning system which is used to provide the conditioned air is also the pressure source for cabin pressurization. Pressure source is irrelevant to operation of the system, since differential pressures and flow across the air outflow valve determine cabin pressure control system requirements.

2. Description

A. Cabin Pressure Control

(1) The cabin pressure control system components control ascent and descent rates within the pressurized areas of the fuselage while approaching the selected cabin altitude. This is done within structural limitations, regardless of ascent and descent rates of the airplane itself. Cabin pressure is normally maintained by opening and closing the cabin air outflow valve through automatic electronic control or by manual control. The cabin air outflow valve consists of two mechanically operated

valves connected by a linkage arrangement. The linkage is automatically controlled by an electrically operated actuator, or manually controlled by the cabin air outflow valve manual control and indicating lever, which is connected by cables to the cabin air outflow valve linkage. The manual control and indicating lever, located on the systems engineer control pedestal in the flight compartment, also indicates the position of the cabin air outflow valve during automatic and manual operation.

(2) When the manual control and indicating lever is raised, power to the automatic control section is removed. The cabin air outflow valve can now be set to any desired position in the control quadrant. To maintain the selected position, the knob is turned 90 degrees and the lever lowered into the control quadrant teeth.

(3) Protection against excessive internal and external pressures to the fuselage is provided by the cabin pressure safety valves and the cargo compartment pressure equalization valves. The safety valves operate automatically to prevent an excessive cabin-to-atmosphere pressure differential. The equalization valves allow pressure between the passenger and lower cargo compartments to equalize automatically.

B. Cabin Pressure Indication

(1) The pressure control system is monitored by the cabin altitude and differential pressure indicator and the cabin rate-of-climb indicator. A cabin low-pressure warning horn sounds intermittently if the cabin pressure altitude reaches approximately 10,000 feet.

3. <u>Operation</u>

A. The cabin pressure control system and cabin pressure indication system are functionally independent. Operation of these systems is described individually under their respective titles.

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CABIN PRESSURE CONTROL - DESCRIPTION AND OPERATION

1. General (See Figure 1.)

   A. The cabin pressure control system is designed to provide the least cabin altitude change permissible within structural limitations of the fuselage, and to accomplish necessary cabin altitude changes at a comfortable rate. The desired cabin altitude can be set on the cabin pressure controller within the range of -1000 to +10,000 feet, and the cabin rate-of-change within the limits of 200 to 900 (±200) feet per minute. With the airplane higher than the selected cabin altitude, the control system attempts to achieve the selected cabin altitude at the rate-of-altitude change selected on the cabin pressure controller. Completion of the selected assignments is accomplished within a range of 0 to 8.77 psi cabin-to-atmosphere differential pressure regardless of airplane ascent or descent rates. The system also provides a means of correcting the controller altitude settings for variations in airport barometric pressure.

   B. The cabin pressure control system consists of the cabin pressure controller, cabin rate controller, cabin pressure control amplifier, cabin pressure air latch and cabin air outflow valve and actuator. The actuator is connected mechanically to the cabin air outflow valve linkage assembly and drives the valve as directed by the amplifier. Relays, circuit breakers, a cabin pressure automatic manual selector switch, and interconnecting wiring complete the system.

   C. Pressure within the cabin is maintained by controlling the amount of air exhausted from the cabin through the cabin air outflow valve. This valve can be controlled automatically by the control system, or manually by adjustment of the manual control and indicating lever. The lever is connected mechanically by cables to the drum on the cabin air outflow valve linkage assembly, and serves as a valve position indicator during automatic operation.

   D. Cabin pressure safety valves are provided to relieve cabin pressure in the event the cabin-to-atmosphere differential pressure exceeds 8.81 (±0.10) psi. Negative pressure relief is provided by cabin doors moving inward.

2. Component Description

   A. Cabin Pressure Controller (See Figure 2.)

      (1) The cabin pressure controller is located on the systems engineer's control panel in the flight compartment. The controller accepts inputs from the altitude selector knob and rate control knob to establish electrical signals that change cabin pressure when a change is required. Housed in the pressure controller are an altitude monitor, a differential pressure monitor, a variable resistor, an altitude selector knob, a

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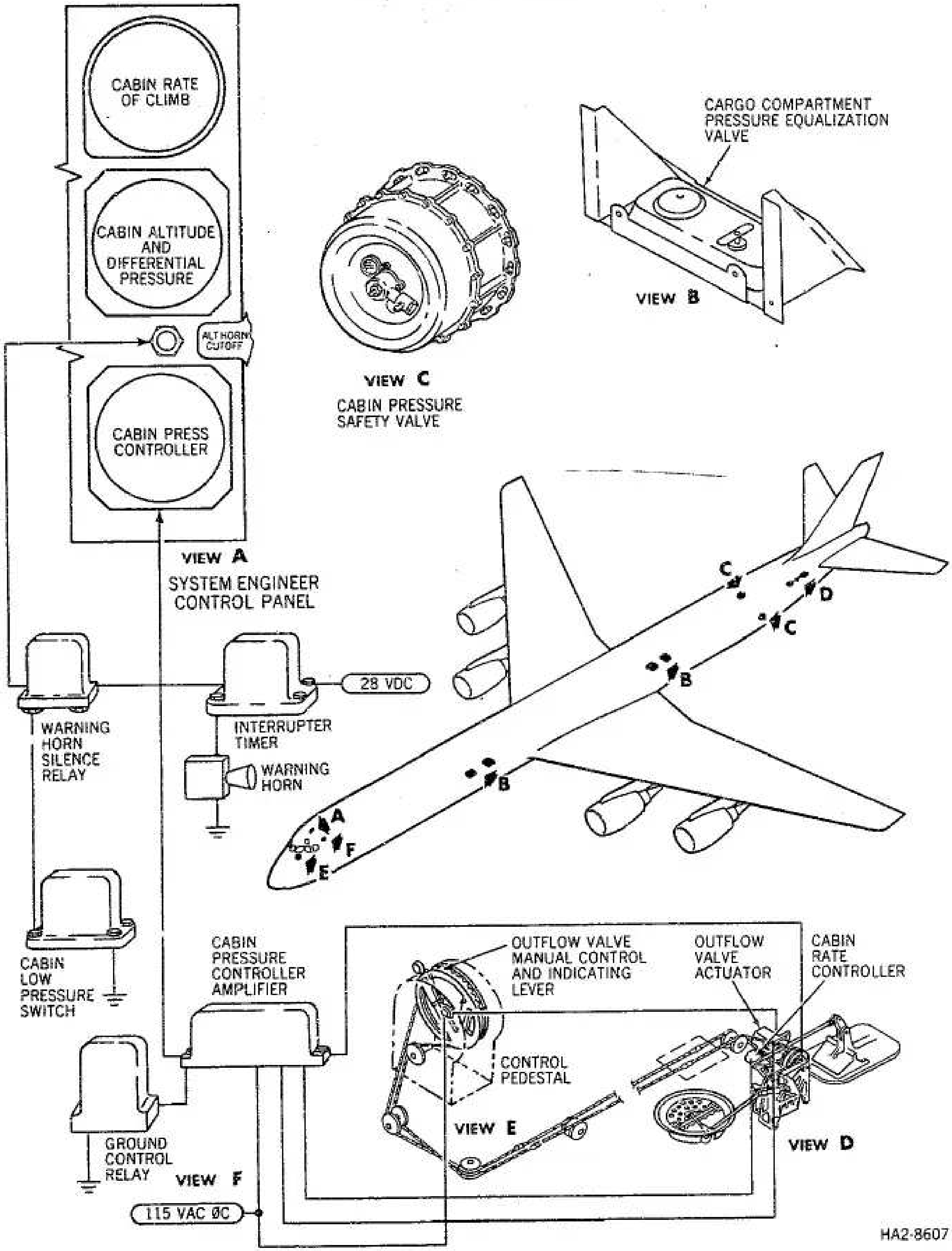
CABIN RATE OF CLIMB
CABIN ALTITUDE AND DIFFERENTIAL PRESSURE
ALT HORN CUTOFF
CABIN PRESS CONTROLLER
VIEW A
SYSTEM ENGINEER CONTROL PANEL
CARGO COMPARTMENT PRESSURE EQUALIZATION VALVE
VIEW B
VIEW C
CABIN PRESSURE SAFETY VALVE
WARNING HORN SILENCE RELAY
INTERRUPTER TIMER
28 VDC
WARNING HORN
CABIN LOW PRESSURE SWITCH
CABIN PRESSURE CONTROLLER AMPLIFIER
OUTFLOW VALVE MANUAL CONTROL AND INDICATING LEVER
OUTFLOW VALVE ACTUATOR
CABIN RATE CONTROLLER
CONTROL PEDESTAL
VIEW E
VIEW D
GROUND CONTROL RELAY
VIEW F
115 VAC ØC
A
B
C
D
E
F

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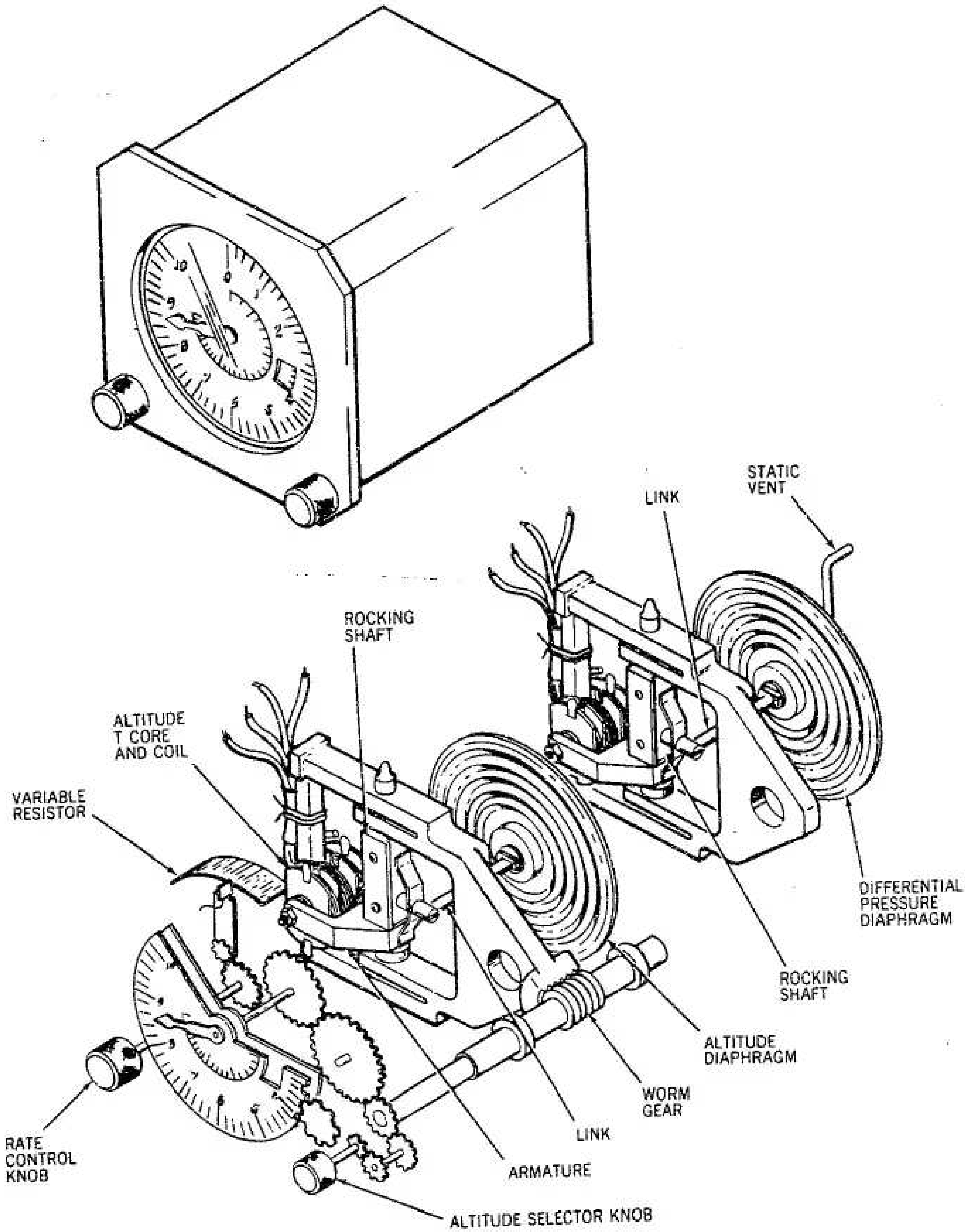
STATIC
VENT
LINK
ROCKING
SHAFT
ALTITUDE
T CORE
AND COIL
VARIABLE
RESISTOR
DIFFERENTIAL
PRESSURE
DIAPHRAGM
ROCKING
SHAFT
ALTITUDE
DIAPHRAGM
WORM
GEAR
LINK
ARMATURE
RATE
CONTROL
KNOB
ALTITUDE SELECTOR KNOB

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rate control knob, a dial and pointer to indicate the selected flight and cabin altitude, and a barometric scale to indicate the barometric setting of the controller.

(2) The altitude monitor includes a closed altitude diaphragm which is sensitive to cabin pressure, a T-core and coil unit, a rocking shaft, an armature, and a slotted link which connects the diaphragm to the rocking shaft. The differential pressure monitor includes a differential pressure diaphragm connected to a static vent, a differential T-core and coil unit, a rocking shaft, an armature, and a slotted link which connects the diaphragm to the rocking shaft. The differential pressure monitor is electrically connected in series with the altitude monitor, but the two monitors are mechanically independent of each other. A C-shaped iron armature is mounted in each rocking shaft, which is connected to the diaphragm by a link. An iron field structure within the armature carries four symmetrically wound coils connected in an inductive bridge (see Figure 3).

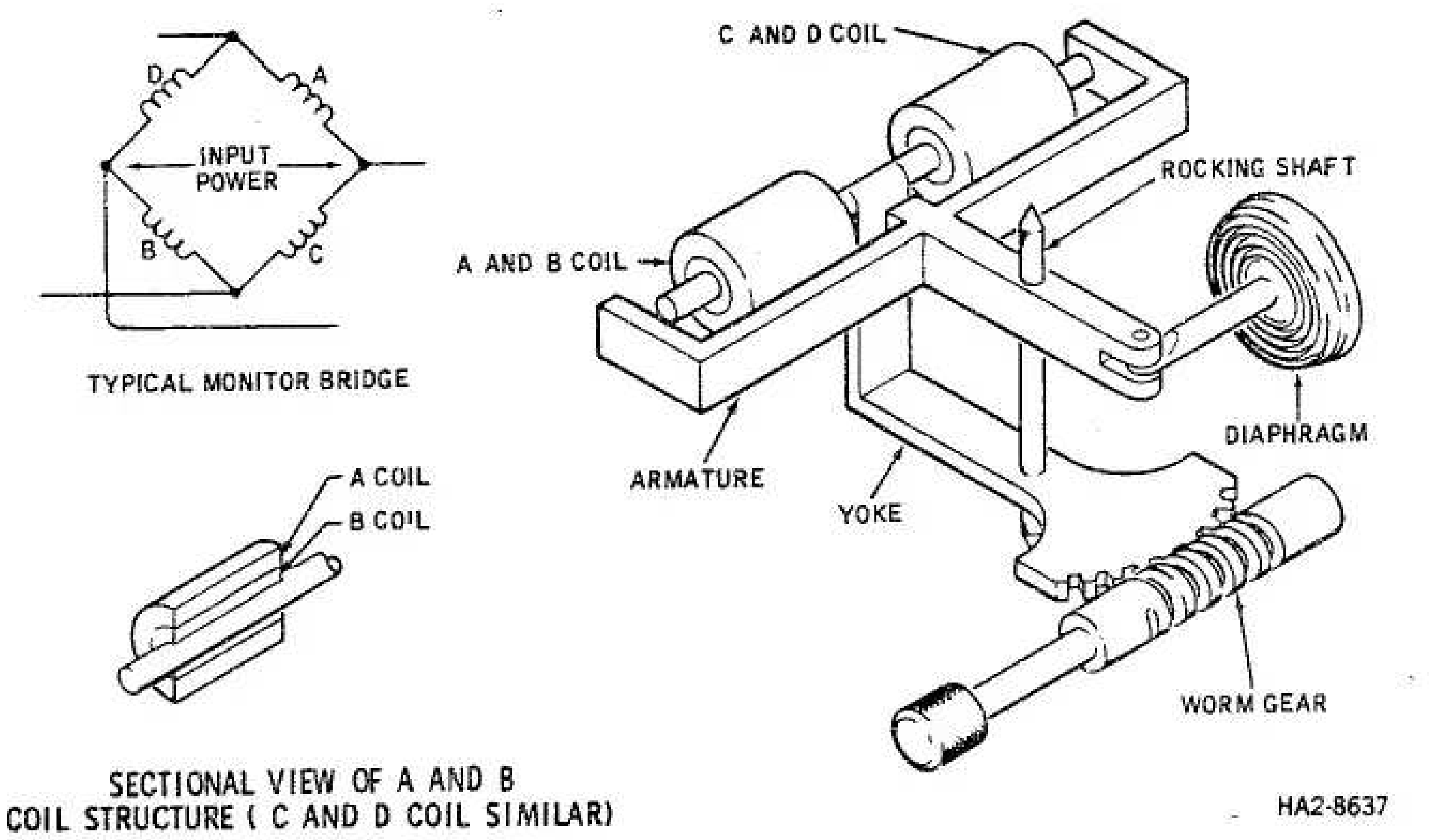
(3) The dial of the instrument contains two concentric scales, the outer scale indicating cabin altitude and the inner scale indicating maximum flight altitude. The cabin altitude scale is marked from -1000 feet to +10,000 feet. The flight altitude scale is marked from 23,000 feet to 50,000 feet. The variable resistor sets the bias of excitation voltage of the altitude monitor and determines the maximum and minimum rate-of-change to which the system will respond.

(4) The rate control knob is connected to the arm of the variable resistor and is used to set the desired rate of change of cabin altitude. A line inscribed on the rate control knob, and index marks adjacent to the knob, indicate the selected rate of cabin altitude change. In the minimum position, the approximate rate of change is 200 feet per minute or less; in the maximum position, the approximate rate of change is 700 feet per minute or greater. Stops prevent the knob from being turned beyond the maximum or minimum position.

(5) The altitude selector knob is used to set the controller to the maximum flight altitude at maximum cabin pressure differential. Because the scales are concentric, setting the flight altitude at maximum pressure differential also sets the corresponding cabin altitude. In the normal, or retracted position, the knob actuates the pointer which indicates the cabin and maximum flight altitude. At the same time the pointer is set, the T-core and coil unit is positioned within the rocking shaft and armature unit. Stops are provided to prevent the pointer from being rotated beyond a position midway between the -1000- and +10,000-foot marking when the hand is being rotated in either direction. When the altitude selector knob is pulled out, the controller can be set to the desired barometric setting. The barometric pressure set on the controller is indicated on a stationary scale visible through a window in the dial. The barometric scale has a range of 28.1 to 31.0 inches of mercury or, if calibrated in millibars, a range of 950 to 1050 millibars. Stops are provided to prevent the dial from being rotated beyond the limits of the barometric scale.

B. Cabin Rate Controller (See Figure 4.)

(1) The cabin rate controller, mounted on the cabin air outflow valve drive bracket, is a rate-of-change of pressure monitor. The unit does not contain any flight adjustable controls and is provided with a blank cover plate. The controller automatically controls the rate-of-change of cabin pressure and contains a pressure-sensing diaphragm and monitor mechanism. The internal operating mechanism of the rate controller is composed of a diaphragm which is actuated by pressure changes within the cabin and rate controller. Pressure from the outflow valve is supplied in the diaphragm through an unrestricted tube and is vented into the rate controller case through a controlled leak capillary. When the air pressure varies because of changes in air velocity in the outflow valve, the pressure change in the case lags behind the pressure change in the diaphragm. The diaphragm reacts to this differential. A C-shaped iron armature is mounted on the rocking shaft, which is connected to the diaphragm by a link. An iron field structure within the armature carries four symmetrically wound coils connected in an inductive bridge (see Figure 3). When the diaphragm expands, due to a change in pressure between the cabin outflow pressure and pressure inside the rate controller (surrounding the diaphragm), the resulting movement causes changes in the field within the armature. When the field changes, the inductance of one side increases while the opposite side decreases, resulting in an output voltage. When the output voltage exceeds the predetermined rate-of-change (set by the rate control knob on the cabin pressure controller), a signal is produced.



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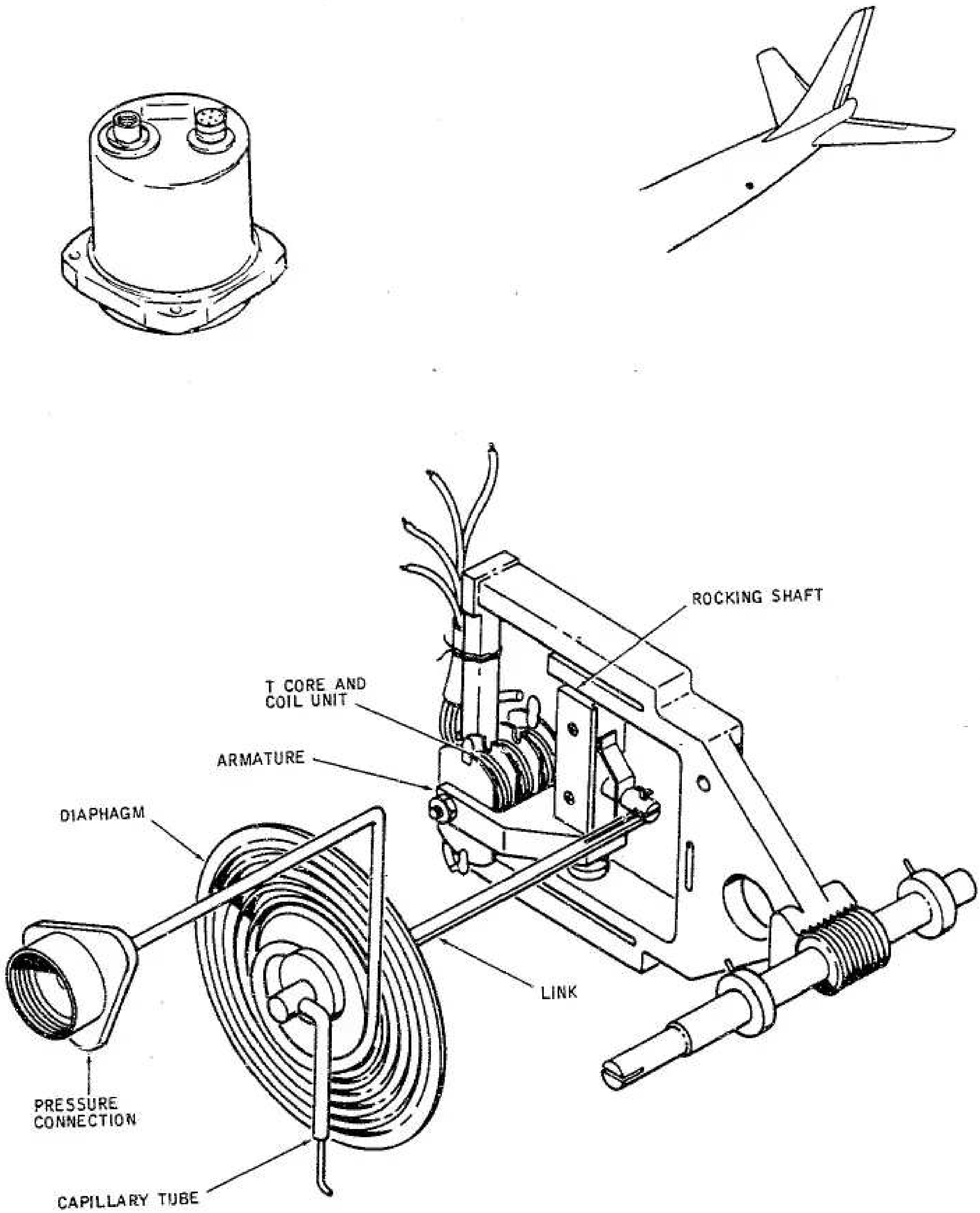
ROCKING SHAFT
T CORE AND
COIL UNIT
ARMATURE
DIAPHAGM
LINK
PRESSURE
CONNECTION
CAPILLARY TUBE

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C. Cabin Pressure Control Amplifier

(1) The cabin pressure control amplifier is located on the forward center equipment panel at the electrical power center. The amplifier contains suitable solid state electronic equipment to sum the inputs from the cabin pressure controller and cabin rate controller, amplify the result, and send a signal of 85 to 95 vac to drive the actuator in the proper direction and speed to attain smooth cabin pressure control.

(2) The amplifier consists of two stages of transistor preamplification and a full-wave magnetic amplifier output stage. The magnetic amplifier stage is a full-wave doubler type, using a center tapped output transformer to provide phase reversal of the output voltage. Bias windings provide an operating point for the magnetic amplifier output by using a small current. Bias current is supplied by a self-contained power supply which also provides dc voltage for the collector and emitter requirements of the preamplifier. The control windings of the magnetic amplifier are split into two coils for each reactor. The coils are interconnected in a manner to assure zero net magnetization in each core for conditions in which equal discriminator loop currents flow. Quadrature-components-of-error signals of 0 or 180 degrees produce appropriate magnetization changes in the magnetic amplifier cores to either cut off a pair of cores or drive the cores to saturation.

(3) The preamplifier is the conventional grounded emitter type using a transformer coupling to provide negative feedback. A constant current bias technique is used for ensuring temperature stability of the transistor collector circuit. The output of the preamplifier is coupled by a transformer to a full-wave phase discriminator network. This network converts the ac error signal into two dc loop currents and the magnitudes and polarities are dependent upon the amplitude and phase of the error signal. The phase and magnitude discrimination is made by comparing the amplifier error signal with the reference voltage. In the control windings, quiescent currents of the phase discriminator (which are always present due to the reference voltage) produce no effect until an error signal is introduced. The phase of the error signal determines which pair of cores are saturated and which pair are cut off.

D. Cabin Air Outflow Valve

(1) The cabin air outflow valve is installed on the airplane centerline in the tail section skin and controls the outflow of air from the cabin, thereby controlling cabin pressure. The valve consists of a butterfly valve and a nozzle valve interconnected by a drive assembly. The drive assembly is connected to, and driven by, the cabin air outflow valve actuator, or is positioned manually in response to movement of the manual control and indicating lever in the flight compartment. In the closed position, both valves are flush with the fuselage skin. The nozzle valve incorporated a ramp-type gate which withdraws into the fuselage as the valve opens. The butterfly valve is located forward of the nozzle valve, and the portion of the valve that protrudes beyond the fuselage skin is parallel to the airstream in flight.

(2) Installed between the butterfly and nozzle valves is the drive assembly which consists of a main shaft, counter shafts, and connecting linkage. Movement of the main shaft is transmitted to the butterfly and nozzle valves through rods connected to bellcranks on the drive assembly. An electrically operated actuator and cable drum are installed on the main shaft, and, an electrically operated clutch within the actuator disengages the actuator drive from the main shaft. Cables are connected from the cable drum on t e main shaft to a cable drum in the control pedestal. Mounted on the cable drum in the control pedestal is the manual control and indicating lever, which also serves as a valve position indicator during automatic and manual operations.

(3) On the ground, the actuator drives the valve open by a ground sense signal through the ground control relays. In this position the nozzle valve is full open and the butterfly valve is limited to 35 (+5) degrees of travel from the full closed position by a mechanical stop and limit switch. A low enough cabin pressure differential is maintained so that doors and flight compartment windows can be opened without discomfort to the occupants when the air conditioning systems are operating. It also limits the change in cabin pressure when the air conditioning systems are turned on. As the airplane ascends, automatic pressure control begins to close the butterfly valve while the nozzle valve remains wide open. The movement between butterfly and nozzle valve operation is accomplished by arrangement of the linkage and bellcranks on the drive assembly. Shortly after liftoff, the butterfly valve is fully closed. From this point on, cabin air outflow is controlled entirely by the nozzle valve. The double- alve arrangement permits accurate control of air outflow and permits handling of greater masses of air at low cabin pressure differential when both valves are open.

(4) By raising the manual control lever knob, a switch actuated by internal mechanism in the lever electrically disengages the clutch from the main shaft of the drive assembly. The lever, which is directly connected by cables to the main shaft of the drive assembly, may now be operated. After lifting the knob on the manual control lever to manual mode of operation, the knob is rotated 90 degrees to align pins on the base of the knob with teeth in the control quadrant. Releasing the knob in this position causes the pins to engage the teeth without returning to automatic mode of operation, and locks the valve in the selected position.

E. Cabin Air Outflow Valve Actuator

(1) The cabin air outflow valve actuator is located on the cabin air outflow valve, and positions the cabin air outflow valve in response to signals from the cabin pressure control amplifier. The actuator consists of an ac induction motor, a solenoid-operated clutch, load-limit switches, and reduction gear train. The actuator is connected to the cabin air outflow valve linkage through the solenoid-controlled clutch and gear train.

(2) When the cabin pressure control system is in automatic mode, the clutch is energized to connect the motor, through the gear train, to the cabin air outflow valve linkage. As the motor rotates either clockwise or counterclockwise, the valve linkage opens or closes the butterfly and nozzle valves. If the valves become obstructed or the linkage jammed, load-limit switches prevent damage to the actuator, valves or linkage. The switches are set to shut off the actuator motor if torque on the output shaft exceeds 325 (±25) inch-pounds and, by using mechanical stops, limit the rotation of the output shaft to 150 (±2) degrees.

(3) When the cabin pressure control system is being manually controlled by the cabin air outflow valve manual control and indicating lever, the amplifier 115-vac output that drives the actuator motor is disconnected. With the loss of power, the clutch is deenergized and the actuator shaft is allowed to run free with manual movement of the valve.

F. Cabin Pressure Safety Valve (See Figure 5.)

(1) The cabin pressure safety valve consists of two principal parts: a base section and a head section. A diaphragm, secured between the two sections, forms a flexible airtight divider. The base section consists of an airflow valve diaphragm, a spring-loaded outflow poppet which rides on an outflow valve pilot and guide, two spring-loaded discs, and a base. The two discs and base mount flush with the airplane skin. The head section contains an atmosphere sensing port, a cabin air sensing port with a filter, a spring-loaded differential diaphragm, and a spring-loaded metering valve.

(2) The valve controls cabin-to-atmosphere pressure differential by releasing cabin air to atmosphere. Cabin air, introduced into the head section of the valve through the cabin air port, acts on one side of the differential diaphragm. Static atmospheric pressure, introduced into the head section of the valve through the atmosphere sensing connection, acts on the opposite side of the differential diaphragm. Pressure relief occurs when the metering valve unseats between 8.82 and 9.09 psi (8.81 and 9.18 psi on indicator) higher than atmospheric pressure. As the metering valve unseats, air flows from the reference pressure chamber through the metering valve and out to atmosphere, thereby reducing pressure in the reference pressure chamber and causing the outflow poppet to open. The pressure differential between reference pressure and cabin pressure across the outflow valve diaphragm causes the poppet to meter cabin air to atmosphere. This action overcomes the tension of the disc return spring and allows the discs to open. The opening and closing of the outflow poppet, because of changes in reference-to-cabin pressure differential, controls the cabin-to-atmosphere pressure differential. Pressure relief continues until cabin air pressure reduces to a pressure lower than that required to cause the differential diaphragm to unseat the metering valve.

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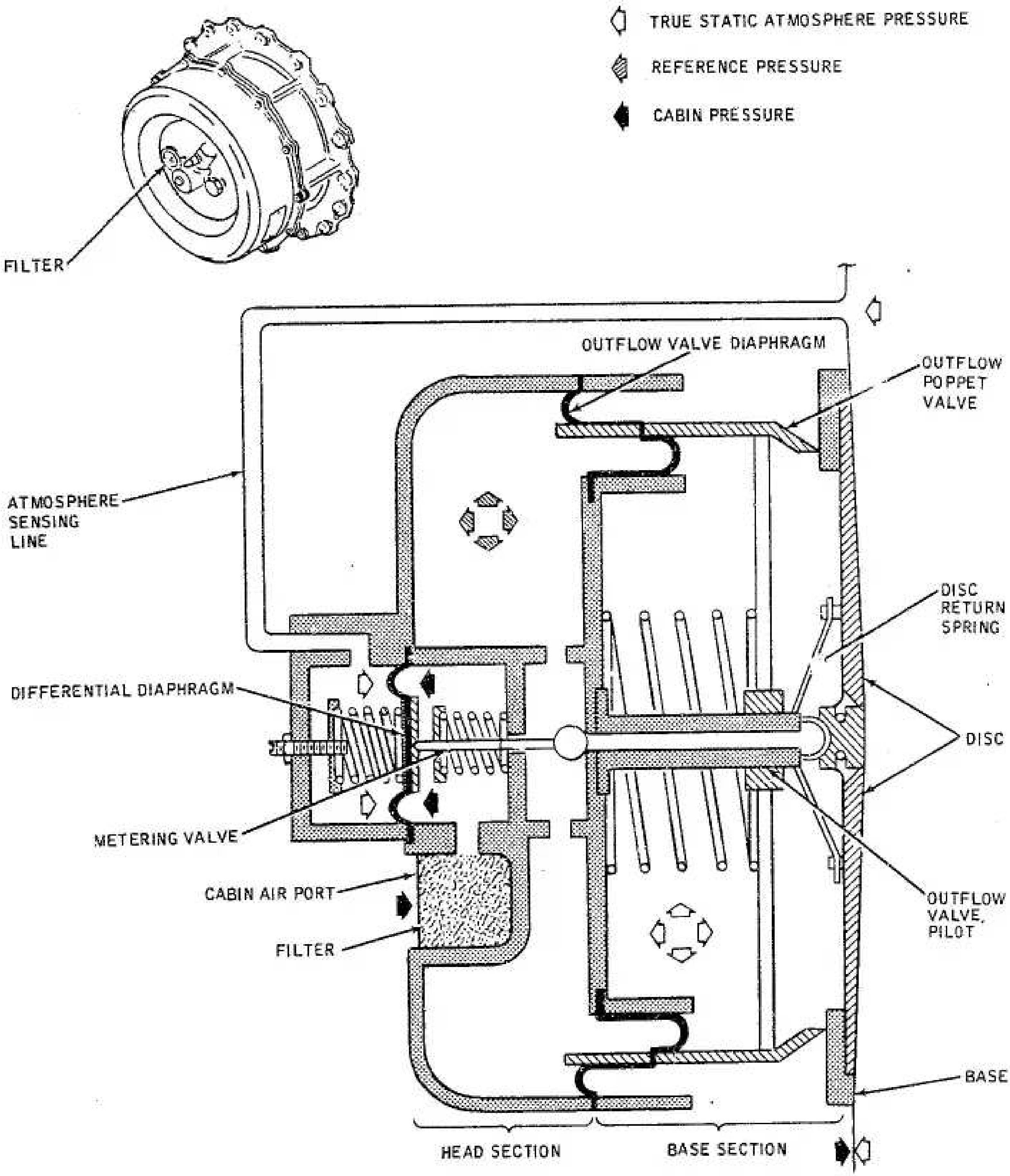
TRUE STATIC ATMOSPHERE PRESSURE
REFERENCE PRESSURE
CABIN PRESSURE
FILTER
OUTFLOW VALVE DIAPHRAGM
OUTFLOW POPPET VALVE
ATMOSPHERE SENSING LINE
DISC RETURN SPRING
DIFFERENTIAL DIAPHRAGM
DISC
METERING VALVE
CABIN AIR PORT
FILTER
OUTFLOW VALVE, PILOT
BASE
HEAD SECTION
BASE SECTION

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G. Cargo Compartment Pressure Equalization Valve

(1) Two cargo compartment pressure equalization valves are installed in the ceiling of each cargo compartment and interconnect with the passenger compartment. The valves prevent differential pressure between the compartments exceeding 0.25 psi.

H. Cabin Pressure Air Latch

(1) The cabin pressure air latch consists of four relays. The solenoids are energized by closing the left and right pack switches, two solenoids for each of the switches. Energizing any one of the solenoids completes a circuit through the latch. The ground control relays and cabin pressure amplifier relay function with the latch to complete the cabin air outflow valve open signal from the cabin pressure control amplifier.

3. System Operation

A. The cabin pressure control system attempts to maintain cabin pressure at the selected altitude and rate-of-altitude change, to enhance passenger comfort, and to avoid excessive stresses on airplane structures. The system is designed for automatic or manual control. Normal operation is automatic after selecting the desired cabin altitude and cabin rate-of-change on the cabin pressure controller. Airport barometric pressure corrected to sea level is also set on the cabin pressure controller prior to takeoff or landing. This setting is, in effect, a vernier control of cabin pressure to minimize pressure bumps during takeoff or landing. The altitude monitor in the cabin pressure controller originates signals which ultimately result in a change in cabin pressure when a change in cabin pressure is required. The differential pressure monitor prevents cabin-to-atmosphere differential pressure from exceeding 8.77 (+0.09) psi. The rate monitor in the cabin rate controller, combined with the variable resistor in the cabin pressure controller, establishes cabin pressure rate-of-change.

B. With the cabin pressure automatic manual switch in automatic position and electrical power applied to the ciruit breaker buses (see Figure 6), the cabin air outflow valve actuator clutch solenoid is energized to engage the clutch with the cabin air outflow valve drive unit. When the airplane is on the ground and any one of the air conditioning packs is turned on, the cabin pressure amplifier control relay is latched closed, an amplifier relay within the cabin pressure control amplifier is energized, and a valve open signal is sent to the cabin air outflow valve actuator. The position of the armature within the altitude monitor can be varied mechanically by either the altitude selector knob or the diaphragm link. The diaphragm link is connected to the altitude diaphragm, which is sealed but externally sensitive to cabin pressure. Turning the cabin pressure controller altitude selector knob sets the pointer on the dial to the desired cabin altitude and also positions the altitude monitor unit with the worm gear. By pulling out the altitude selector knob, the airport barometric pressure

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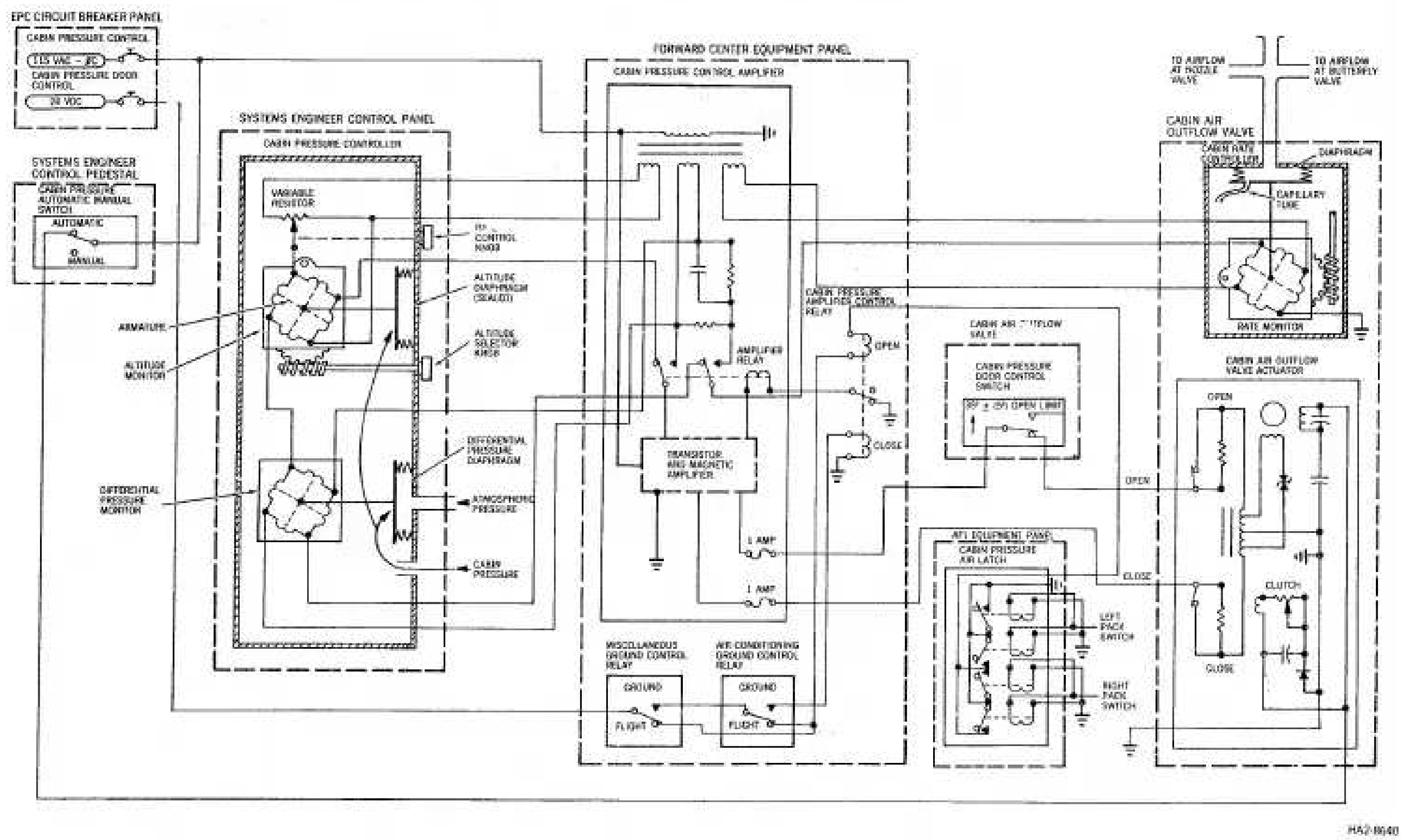
can be set on the controller dial. This is a vernier setting which compensates for the position of the diaphragm link relative to the cabin pressure. The rate control knob positions the variable resistor to set the bias of excitation voltage of the altitude monitor. This setting determines the rate-of-change of altitude to which the system responds.

C. On the ground, with both air conditioning packs operating, the cabin altitude descends below air ɔrt altitude (as set on the controller) with windows and doors closed. At takeoff, with any one or both air conditioning packs operating, ground control relay contacts close to energize the open solenoid of the cabin pressure control relay, the amplifier relay is deenergized, and the valve open signal is cut off. Control of the valve position is now maintained by the altitude monitor, the differential pressure monitor, and the rate monitor, through the cabin pressure control amplifier.

D. The altitude selector knob is invariably set above airport altitude; therefore, the altitude monitor attempts to maintain a valve open position (depressurized condition) until the airplane reaches the desired cabin pressure. The output voltage from the altitude monitor is 180 degrees out of phase with the output voltage of the rate monitor. The value of the fixed voltage applied at the altitude monitor is determined by the setting of the rate control knob on the cabin pressure controller. Therefore, the rate control knob setting selects the amount of error signal voltage delivered by the altitude monitor. The setting determines the amount of rate monitor signal voltage required to equal the voltage from the altitude monitor. As the airplane climbs with the valve open, the rate monitor notices the climb and begins to restrain the action of the altitude monitor by emitting an increasingly strong opposing signal. The relatively strong signal negates the altitude monitor signal, causing the valve to close so that the rate of climb of the cabin does not exceed the amount set on the cabin pressure controller. As the airplane continues to climb, the rate monitor allows the altitude monitor to attain the selected altitude, but only at the rate determined by the rate setting.

E. During descent, similar commands and countercommands are made to maintain cabin differential pressures as required by the cabin pressure controller. Manual adjustments are made in flight to ensure that cabin pressure is maintained at a minimum and that cabin pressure equals airport altitude when the airplane lands. Ground control relays actuated during touchdown energize the close solenoid of the cabin pressure amplifier control relay. Closing the relay contacts energizes the amplifier relay in the cabin pressure control amplifier, and a valve open signal is sent to the cabin air outflow valve actuator. Valve opening speed is controlled to depressurize the cabin (if the cabin is not already at airport altitude) at a rate of approximately 800 feet per minute.

F. Manual operation of the cabin pressure control system, which completely overrides automatic operation, is accomplished by physically closing or opening the cabin air outflow valve with the manual control and indicating



Cabin Pressure Control -- Schematic
Figure 6

lever on the systems engineer's control pedestal. The manual control lever rack in the control pedestal allows the spring-loaded manual control knob to be locked in any position over the operating range. When the knob is raised, the cabin pressure automatic manual switch is set to deenergize the actuator clutch which disengages the actuator drive from the cabin air outflow valve. During manual operation in flight, cabin pressures and rate changes can be maintained by observing the cabin altitude and differential pressure indicator and the abin rate-of-climb indicator and by making the necessary adjustments with the manual control and indicating lever.

4. To Operate System

A. Manually Pressurize Cabin

(1) Close airplane doors and windows.

NOTE: Do not cover drain holes and venturis that are normally open.

(2) Position switches and controls as follows:

Control	Position
Left pack switch	Off
Right pack switch	Off
Recirculating fan switch	Off
Air conditioning temperature control	Automatic mode

NOTE: Cabin pressure control system is in automatic mode when cabin air outflow valve manual control and indicating lever knob is parallel with control quadrant. Cabin pressure control system is in manual mode when manual control and indicating lever knob is extended and turned 90 degrees, allowing the lever to be locked in any position over the operating range.

(3) Pressurize airplane pneumatic manifold (see Chapter 36).

(4) Start any air conditioning pack (see 21-00, Description and Operation).

NOTE: Start additional air conditioning pack if necessary to obtain required differential pressure.

(5) Pressurize cabin at a comfortable rate by slowly pushing cabin air outflow valve manual control and indicating lever forward toward increase position.

CAUTION: CABIN PRESSURE SAFETY VALVES SHOULD RELIEVE AT 8.81 (+0.10) PSI DIFFERENTIAL PRESSURE. DO NOT ALLOW CABIN-TO-AMBIENT DIFFERENTIAL PRESSURE TO EXCEED 9.1 PSI IF SAFETY VALVES FAIL TO OPEN.

(6) When desired differential pressure is achieved, place and lock cabin air outflow valve control and indicating lever to the full increase position.

(7) Place air conditioning pack switches in off position.

NOTE: Stop air conditioning packs immediately after locking the lever

in increase position to prevent cabin pressure from exceeding the relief valve opening pressure.

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CABIN PRESSURE CONTROL - MAINTENANCE PRACTICES

1. General

A. Test procedures are presented for checking the functionality of the cabin pressure control system using a ground pneumatic source with controlled temperature and pressure. Separate tests are provided for testing the system at airports below 1000-foot altitude and above 1000-foot altitude. Informative notes are provided in the tests to assist in troubleshooting.

B. A cabin pressure decay test for measuring the rate of cabin decay from 8 to 7 psi can be performed using inboard engines. If only a limited ground pneumatic air supply at the rate of 120 pounds per minute at 25 psig and 350°F is available, perform the cabin pressure test for measuring the rate

of cabin pressure decay from 3 to 2 psi. The higher differential pressure test is more representative of actual operation conditions.

C. Further tests are provided using the cabin pressurization system analyzer. The analyzer is connected into the cabin pressure control system between the airplane wiring and the cabin pressure controller amplifier. The analyzer isolates malfunctions to individual components, as well as checking complete system operation.

2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Calibrated vacuum source	2000 or 2024	Burton Instrument Co.	Reduce pressure at static port of a pressurization system component
B.	Static port test adapter	2078	Burton Instrument Co.	Connecting calibrated vacuum source to a static port
C.	Cabin pressurization system analyzer	4767461	Douglas Aircraft Co., Inc.	Testing installed system on ground or in flight

Item	Name	Number	Manufacturer	Use
D	Calibrated rate-of-climb indicator			Compare with airplane instrument
E	Calibrated altimeter			Compare with airplane cabin altitude and differential pressure indicator
F	Calibrated differential-pressure gage			Observe cabin pressure

3. Adjustment Test Cabin Pressure Control Using Pneumatic Source

A. Test Cabin Pressure Control System at Airport Altitude Less Than 1000 Feet

(1) Close airplane doors and windows.

NOTE: Do not cover drain holes and venturis that are normally open.

(2) Check that differential pressure pointer indicates zero, and cabin altitude pointer indicates local uncorrected pressure altitude on cabin altitude and differential pressure indicator on systems engineer's control panel.

(3) Pull out altitude selector knob on cabin pressure controller and set to airport barometric pressure (corrected to sea level).

NOTE: Standard atmospheric pressure at sea level is considered to be 29.92 inches Hg, with corresponding decreases to be found at any given altitude. Thermal conditions cause the barometric pressure to vary from this standard, and when the local barometric pressure is found to be above or below the standard for that altitude, the pressure controller must be corrected to allow for the difference.

(4) Push in altitude selector knob and set pointer on altitude scale to airport elevation.

(5) Open pneumatic crossfeed valve circuit breaker located on heat, vent, and ice protection dc section of EPC circuit breaker panel.

(6) Connect jumper between terminals A1 and A2 of engine 4 ground control relay (see Wiring Diagram Manual).

WARNING: OTHER TERMINALS IN AREA MIGHT BE ENERGIZED.

NOTE: Subsequent procedures require opening the left ground control relay circuit breaker to permit the cabin air outflow valves to operate on the ground. Opening this circuit breaker also deenergizes engine 4 ground control relay, which would close the crossfeed valve in the pneumatic manifold if the jumper were not installed.

(7) Push in altitude selector knob and set pointer on altitude scale to airport elevation.

R (8) Connect jumpers between D1 and D2 of right and left air conditioning
R system ground relays (see Wiring Diagram Manual).

(9) Pressurize airplane pneumatic manifold (see Chapter 36).

(10) Start both air conditioning packs (see 21-00).

(11) Open left ground control relay circuit breaker located on miscellaneous ac buses section of EPC circuit breaker panel.

WARNING: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(12) Check that cabin does not pressurize.

(13) Set rate control knob on cabin pressure controller to minimum position.

(14) With altitude selector knob pushed in, set pointer on altitude scale to -1000 feet. Cabin should begin to pressurize, and cabin rate-of-climb indicator should indicate a stabilized descent between 0 and 275 feet per minute.

NOTE: Lightly tap the rate-of-climb indicator to ensure an accurate indication. If cabin does not begin to pressurize, perform step (15).

(15) Slowly turn rate control knob from minimum position until cabin begins to pressurize, and make observations given in step (14).

(16) Continue descent at any desired rate until cabin altitude and differential pressure indicator stabilizes and cabin pressure is no longer increasing.

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NOTE: The cabin altitude pointer does not indicate below zero. The indicated differential pressure varies with airport altitude and barometric pressure.

(17) Set rate control knob to minimum position.

(18) Set pointer on altitude scale to airport altitude. Cabin should begin to depressurize.

NOTE: If cabin does not begin to depressurize, perform step (19).

(19) Slowly turn rate control knob from minimum position until cabin begins to depressurize and make observations given in step (18).

(20) Continue climb at any desired rate until differential pressure indication stabilizes at zero.

(21) Close left ground control circuit breaker located on miscellaneous ac bus section of EPC circuit breaker panel.

(22) Open right ground control relay circuit breaker located on miscellaneous ac bus section of EPC circuit breaker panel.

(23) Set rate control knob on cabin pressure controller to maximum position.

(24) Set pointer on altitude scale with altitude selector knob pushed in to -1000 feet. Cabin should begin to pressurize, and cabin rate-of-climb indicator should indicate a stabilized descent between 0 and 500 feet per minute.

(25) Continue descent at any desired rate until cabin altitude and differential pressure indicator stabilizes and cabin pressure is no longer increasing.

(26) Set pointer on altitude scale to airport altitude. Cabin should begin to depressurize at a stabilized descent of 500 feet per minute.

NOTE: It is not necessary to completely depressurize cabin.

(27) Set pointer on altitude scale with altitude selector knob pushed in to -1000 feet.

(28) Continue descent at any desired rate until cabin altitude and differential pressure indicator stabilizes and cabin pressure is no longer increasing.

(29) Stop left air conditioning pack by placing left pack switch in off position. Check that cabin air outflow valve manual control and indicating lever moves towards increase position. When lever stabilizes, perform step (30).

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(30) Perform step (29) for right air conditioning pack.

(31) Check that cabin air outflow valve manual control and indicating lever is in full increase position and cabin begins to depressurize.

(32) Start left or right air conditioning pack, and allow cabin pressure to stabilize.

(33) Close right ground control relay circuit breaker located on miscellaneous ac bus section of EPC circuit breaker panel.

(34) Check that cabin begins to depressurize at a stabilized rate-of-change between 600 and 975 feet per minute.

(35) Stop air conditioning packs.

(36) Disconnect jumper from terminals A1 and A2 on engine 4 ground control
R relay. Disconnect jumper from terminals D1 and D2 on left and right

R air conditioning system ground relays.

(37) Close pneumatic crossfeed valve circuit breaker located on heat, vent, and ice protection dc section of EPC circuit breaker panel.

(38) Close right ground control relay circuit breaker located on miscellaneous ac buses section of EPC circuit breaker panel.

(39) Depressurize airplane pneumatic manifold.

B. Test Cabin Pressure Control System at Airport Altitude More Than 1000 Feet

(1) Close airplane doors and windows.

NOTE: Do not cover drain holes and venturis that are normally open.

(2) Check that differential pressure pointer indicates zero and cabin altitude pointer indicates local uncorrected pressure altitude on cabin altitude and differential pressure indicator located on systems engineer's control panel.

(3) Pull out altitude selector knob on cabin pressure controller and set to airport barometric pressure (corrected to sea level).

NOTE: Standard atmospheric pressure at sea level is considered to be 29.92 inches Hg, with corresponding decreases to be found at any given altitude. Thermal conditions cause the barometric pressure to vary from this standard, and when the local barometric pressure is found to be above or below the standard for that altitude, the pressure controller must be corrected to allow for the difference.

(4) Push in altitude selector knob and set pointer on altitude scale to airport elevation.

(5) Open pneumatic crossfeed valve circuit breaker located on heat, vent, and ice protection dc section of EPC circuit breaker panel.

(6) Connect jumper between terminals A1 and A2 of engine 4 ground control relay (see Wiring Diagram Manual).

WARNING: OTHER TERMINALS IN AREA MIGHT BE ENERGIZED.

NOTE: Subsequent procedures required opening the left ground control relay circuit breaker to permit the cabin outflow valves to operate on the ground. Opening this circuit breaker also deenergizes engine 4 ground control relay, which would close the crossfeed valve in the pneumatic manifold if the jumper were not installed.

(7) Push in altitude selector knob and set pointer on altitude scale to airport elevation.

R (8) Connect jumpers between terminals D1 and D2 of right and left air
R conditioning system ground relays (see Wiring Diagram Manual).

(9) Pressurize airplane pneumatic manifold (see Chapter 36).

(10) Start left and right air conditioning packs (see 21-00).

(11) Open left ground control relay circuit breaker located o miscellaneous ac bus section of EPC circuit breaker panel.

WARNING: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(12) Check that cabin does not pressurize.

(13) Set rate control knob on cabin pressure controller to minimum position.

(14) Set pointer on altitude scale to approximately 2000 feet below airport altitude. Cabin should begin to pressurize, and cabin rate-of-climb indicator should indicate a stabilized descent between 0 and 275 feet per minute.

NOTE: Lightly tap the rate-of-climb indicator to ensure an accurate indication. If cabin does not begin to pressurize, perform step (15).

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(15) Slowly turn rate control knob from minimum position until cabin begins to pressurize, and make observations given in step (14).

(16) Set rate control knob to maximum position. Check that cabin rate-of-climb indicator indicates a stabilized descent of 500 feet per minute.

(17) Continue descent until cabin altitude and differential pressure indicator stabilizes and cabin pressure is no longer increasing.

NOTE: The cabin altitude pointer does not indicate below zero, and the differential pressure reached varies with airport altitude and barometric pressure.

(18) Set rate control knob to minimum position.

(19) Set pointer on altitude scale to airport altitude. Cabin should begin

to depressurize, and cabin rate-of-climb indicator should indicate a stabilized climb between 0 and 275 feet per minute.

NOTE: If cabin does not begin to depressurize, perform step (20).

(20) Slowly turn rate control knob from minimum position until cabin begins to depressurize and make observations given in step (19).

(21) Set rate control knob on cabin pressure controller to maximum position. Cabin rate-of-climb indicator should indicate a stabilized descent at 500 feet per minute, and cabin differential pressure shou`d go to zero.

(22) Close left ground control circuit breaker located on miscellaneous ac bus section of EPC circuit breaker panel.

(23) Open right ground control relay circuit breaker located on miscellaneous ac bus section of EPC circuit breaker panel.

(24) Set rate control knob on cabin pressure controller to maximum position.

(25) Set pointer on altitude scale to 2000 feet below airport altitude.

(26) Continue descent at any desired rate until cabin altitude and differential pressure indicator stabilizes and cabin pressure is no longer increasing.

NOTE: The cabin altitude pointer does not indicate below zero, and the differential pressure reached varies with airport altitude and barometric pressure.

(27) Place left pack switch in off position. Check that cabin air outflow valve manual control and indicating lever moves towards increase position.

(28) When lever stabilizes, perform step (29).

(29) Perform step (27) for right pack.

(30) Check that cabin air outflow valve manual control and indicating lever is in full increase position and cabin begins to depressurize.

(31) Start either left or right pack and allow cabin pressure to stabilize.

(32) Close right ground cont. ol relay circuit breaker located on miscellaneous ac bus section of EPC circuit breaker panel.

(33) Check that cabin begins to depressurize at a stabilized rate-of-change within 600 to 975 feet per minute.

(34) Stop air conditioning packs.

(35) Disconnect jumper from terminals A1 and A2 of engine 4 ground control

R relay. Disconnect jumpers from terminal D1 and D2 of right and left
R air conditioning system ground relays.

(36) Close pneumatic crossfeed valve circuit breaker located on heat, vent, and ice protection dc section of EPC circuit breaker panel.

(37) Close right ground control relay circuit breaker located on miscellaneous ac bus section of EPC circuit breaker panel.

(38) Depressurize airplane pneumatic manifold.

C. Cabin Pressure Decay Test Between 8 and 7 psi with Engine Operating

(1) Close airplane doors and windows.

NOTE: Do not cover drain holes and venturis that are normally open.

(2) Position switches and controls as follows.

Control	Position
Left air conditioning pack	Off
Right air conditioning pack	Off
Recirculating fan switch	Off
Air-conditioning control	Automatic mode

NOTE: The cabin pressure control system is in automatic mode when the cabin air outflow valve manual control and indicating lever knob is parallel with the control quadrant. The cabin pressure system is in manual mode when the manual control and indicating lever knob is extended and turned 90 degrees, allowing the lever to be locked in any position over the operating range.

R (3) Deleted

(4) Start left or right air conditioning pack (see 21-00, Description and Operation).

NOTE: Start additional air conditioning pack if necessary to obtain required differential pressure.

(5) Pressurize cabin at a comfortable rate by slowly pushing cabin air outflow valve manual control and indicating lever forward toward increase position.

position.

CAUTION: CABIN PRESSURE SAFETY VALVES SHOULD RELIEVE AT 8.81 (±0.10) PSI DIFFERENTIAL PRESSURE. DO NOT ALLOW CABIN-TO-AMBIENT DIFFERENTIAL PRESSURE TO EXCEED 9.1 PSI IF SAFETY VALVES FAIL TO OPEN.

(6) When desired differential pressure is achieved, place and lock cabin air outflow valve control and indicating lever to full increase position.

(7) Stop air conditioning packs.

NOTE: The air conditioning packs are stopped immediately after locking the lever in increase position to prevent cabin pressure from exceeding the relief valve opening pressure.

(8) With an accurate stop watch, measure time for cabin differential pressure to drop from 8 to 7 psig. Maximum acceptable tolerance at applicable airport altitude is given in Figure 201.

NOTE: The cabin altitude and differential pressure indicators should be tapped lightly during the test to ensure accurate readings.

(9) Place cabin pressure manual control and indicating lever in automatic mode.

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Test Altitude (Feet)	Minimum Time for Decay from 8 to 7 psig (Seconds)
Sea Level	43.5
1000	44.5
2000	45.5
3000	46.5
4000	47.5
5000	48.5

6000	49.5
7000	50.5
8000	51.5
9000	52.5
10,000	53.5

Altitude Versus Decay Time Chart
Figure 201

(10) Allow cabin pressure to depressurize to zero.

D. Cabin Pressure Decay Test Between 3 and 2 psi

(1) Close airplane doors and windows.

NOTE: Do not cover drain holes and venturis that are normally open.

(2) Position switches and controls as follows.

Control	Position
Left air conditioning pack	Off
Right air conditioning pack	Off
Recirculating fan switch	Off

TOC

NOTE: The cabin pressure control system is in automatic mode when the cabin air outflow valve manual control and indicating lever knob is parallel with the control quadrant. The cabin pressure system is in manual mode when the manual control and indicating lever knob is extended and turned 90 degrees, allowing the lever to be locked in any position over the operating range.

R (3) Deleted.

(4) Pressurize airplane pneumatic manifold (see Chapter 36).

(5) Start left or right air conditioning pack (see 21-00, Description and Operation).

NOTE: Start additional air conditioning pack if necessary to obtain required differential pressure.

(6) Pressurize cabin at a comfortable rate by slowly pushing cabin air out-

flow valve manual control and indicating lever forward toward increase position.

CAUTION: CABIN PRESSURE SAFETY VALVES SHOULD RELIEVE AT 8.81 ($\pm$0.10) DIFFERENTIAL PRESSURE. DO NOT ALLOW CABIN-TO-AMBIENT DIFFERENTIAL PRESSURE TO EXCEED 9.1 PSIG IF SAFETY VALVES FAIL TO OPEN.

(7) When differential pressure is 3.5 psi, place and lock cabin air outflow valve control and indicating lever to full increase position.

(8) Stop air conditioning packs.

(9) With an accurate stop watch, measure time for cabin differential pressure to drop from 3 to 2 psig. Maximum acceptable tolerance at applicable airport altitude is given in Figure 202.

NOTE: The cabin altitude and differential pressure indicators should be tapped lightly during the test to ensure accurate readings.

Test Altitude (Feet)	Minimum Time for Decay from 3 to 2 psig (Seconds)
Sea Level	62.0
1000	64.0
2000	65.5
3000	67.5

Altitude Versus Decay Time Chart
Figure 202 (Sheet 1)

TOC

Test Altitude (Feet)	Minimum Time for Decay from 3 to 2 psig (Seconds)
4000	69.5
5000	71.0
6000	73.0
7000	75.0
8000	77.5

9000	79.5
10,000	81.5

Altitude Versus Decay Time Chart
Figure 202 (sheet 2)

(10) Place cabin pressure manual control and indicating lever in automatic mode.

(11) Allow cabin to depressurize to zero.

(12) Depressurize airplane pneumatic manifold (see Chapter 36).

E. Test Cabin Pressure Control System Using Analyzer Without Cabin Pressurized

(1) Move cabin air outflow valve manual control and indicating lever from full increase to full decrease position in manual mode. Check for freedom of movement of cabin air outflow valve and manual control cable system.

NOTE: The cabin pressure control system is in automatic mode when the cabin air outflow valve manual control and indicating lever knob is parallel with the control quadrant. The cabin pressure system is in manual mode when the manual control and indicating lever knob is extended and turned 90 degrees, allowing the lever to be locked in any position over the operating range.

(2) Open cabin pressure control circuit breaker located on heat, vent, and ice protection ac section of EPC circuit breaker panel.

(3) Disconnect cabin pressure controller amplifier electrical connector (see Wiring Diagram Manual).

(4) Connect analyzer plugs to amplifier and amplifier electrical connector. Connect analyzer ground terminal to airplane bare metal ground (see Figure 203).

(5) Place switch on analyzer in system (3V or 10V) position.

NOTE: When the switch is in system (3V or 10V) position, cabin pressure control system operation is controlled by airplane components. The analyzer input and output meters indicate system input and output voltages.

(6) Open left and right ground control relay circuit breakers located on miscellaneous ac bus section of EPC circuit breaker panel.

WARNING: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(7) Close cabin pressure control circuit breaker located on heat, vent, and ice protection ac section of EPC circuit breaker panel.

(8) Check that ac power lights on analyzer panel come on.

NOTE: If lights do not come on, check airplane power circuits (see Wiring Diagram Manual).

(9) Place airplanes voltage selector switch, located on systems engineer's control panel, to ac position, and check that airplane ac voltmeter indicates 115 (±3) vac.

(10) Place and hold meter select switch on analyzer panel. Check that analyzer input meter indicates 1.3 (±0.1) volts and output meter indicates 50 (±4) volts. Release switch.

NOTE: If input and output meter indications are not within limits, analyzer should be calibrated.

(11) Place switch on analyzer in pressure control (3V or 10V) position.

(12) Set control knob on cabin pressure controller to minimum position.

(13) Push in altitude selector knob and set pointer on altitude scale to -1000 feet and then to +1000 feet from cabin altitude. Check that input meter on analyzer indicates within the minimum rate band in both settings.

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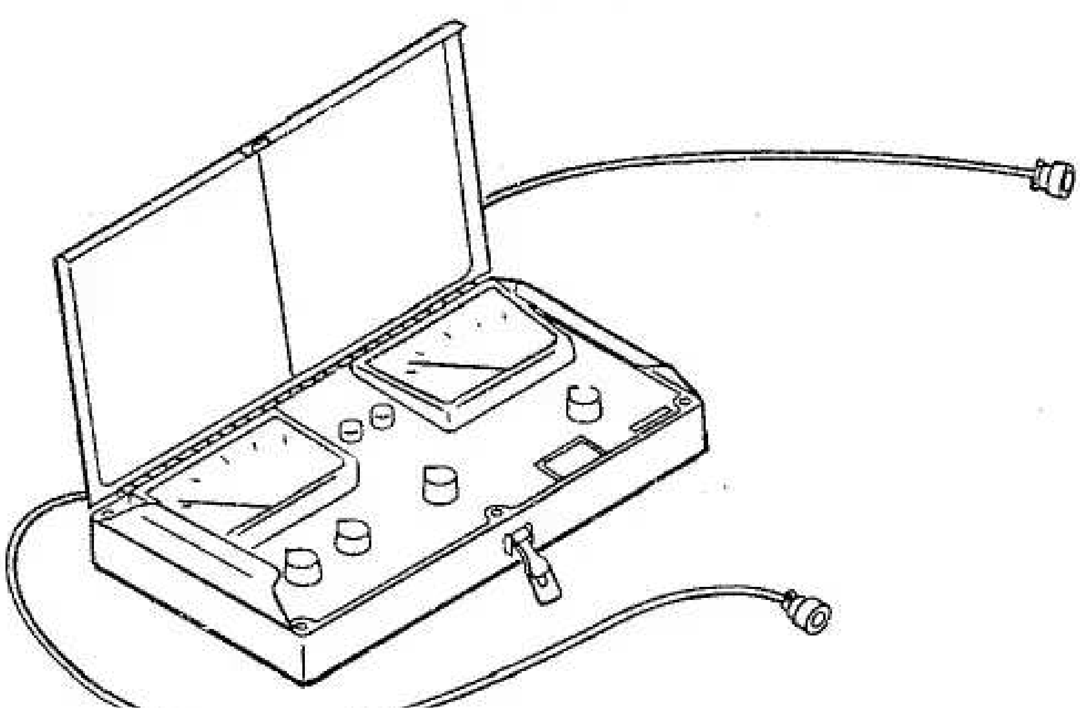

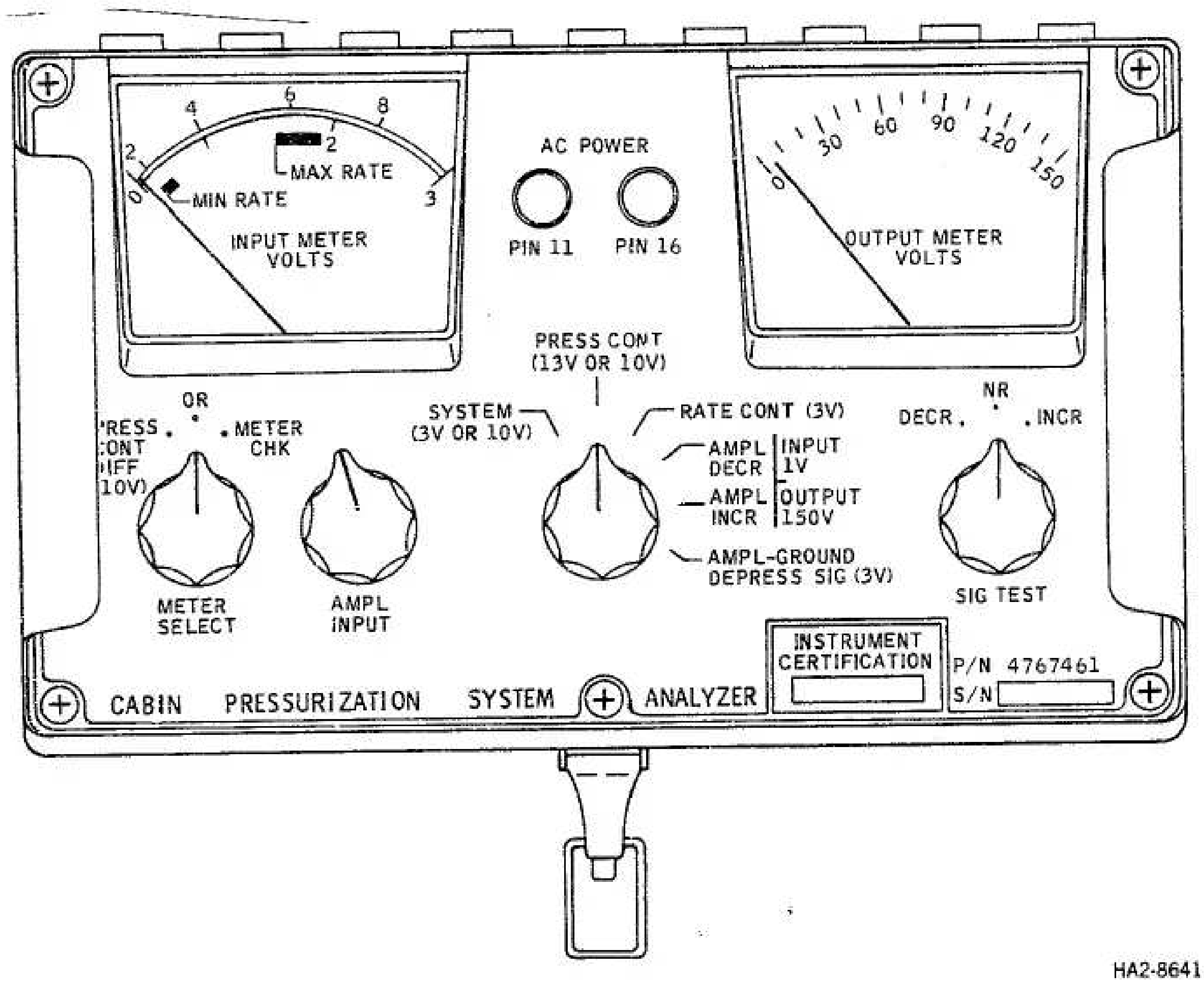

Cabin Pressurization System Analyzer
Figure 203

TOC

See TR 21-7 below.

(14) Set rate contro

(15) Set pointer on altitude scale to -1000 feet and then to +1000 feet from cabin altitude. Check that input meter indicates within the maximum rate band at both settings.

(16) With rate control knob in any position, position altitude selector until input meter indicates within null band. Check that altitude pointer is ±200 feet from cabin altitude.

(17) Place switch on analyzer in rate control (3V) position. Check that input meter indicates within null band.

(18) Place cabin air outflow valve manual control and indicating lever in midposition and lock in manual mode.

(19) Place switch on analyzer in amplifier increase position.

(19) Place switch on analyzer in amplifier increase position.

(20) Adjust amplifier input knob on analyzer until input meter indicates 0.35. Check that output meter indicates between 20 and 35.

(21) Place switch in amplifier decrease position.

(22) Maintain input meter indication at 0.35, and adjust amplifier gain potentiometer (located under dust cap above amplifier connector) until output meter indicates 26.

(23) Place switch in amplifier increase position. Check that output meter indicates between 22 and 30.

(24) Place switch on analyzer in amplifier increase position.

(25) Place cabin air outflow valve manual control and indicating lever in midposition in automatic mode.

(26) Adjust amplifier input knob on analyzer until input meter indicates 0.8 volts. Check that output meter indicates within black band and that manual control and indicating lever moves towards increase position.

(27) Place and hold signal test switch on analyzer in increase position. Check that output meter indicates between 83 and 130. Release switch.

(28) Place switch on analyzer in decrase position.

(29) Adjust amplifier input knob until input meter indciates 0.18 volts. Check that output meter indicates within black band and that manual control and indicating lever moves towards decrease position.

(30) Place and hold signal test switch on analyzer in decrease position. Check that output meter indicates between 83 and 130. Release switch.

TEMPORARY REVISION 21-7

FILING INSTRUCTIONS: Insert this Temporary Revision adjacent to 21-31-0, Page 215, CODE 50, Maintenance Practices.

Retain this Temporary Revision until notified to remove it.

DESCRIPTION AND REASON: This Temporary Revision revises paragraph 3.E. step (29) to callout correct meter indication.

EFFECTIVITY: ALL

(14) Set rate control knob to maximum position.

(15) Set pointer on altitude scale to -1000 feet and then to +1000 feet from cabin altitude. Check that input meter indicates within the maximum rate band at both settings.

(16) With rate control knob in any position, position altitude selector until input meter indicates within null band. Check that altitude pointer is ±200 feet from cabin altitude.

(17) Place switch on analyzer in rate control (3V) position. Check that input meter indicates within null band.

(18) Place cabin air outflow valve manual control and indicating lever in midposition and lock in manual mode.

(19) Place switch on analyzer in amplifier increase position.

(20) Adjust amplifier input knob on analyzer until input meter indicates 0.35. Check that output meter indicates between 20 and 35.

(21) Place switch in amplifier decrease position.

(22) Maintain input meter indication at 0.35, and adjust amplifier gain potentiometer (located under duct cap above amplifier connector) until output meter indicates 26.

(23) Place switch in amplifier increase position. Check that output meter indicates between 22 and 30.

(24) Place switch on analyzer in amplifier increase position.

(25) Place cabin air outflow valve manual control and indicating lever in midposition in automatic mode.

(26) Adjust amplifier input knob on analyzer until input meter indicates 0.8 volts. Check that output meter indicates within black band and that manual control and indicating lever moves towards increase position.

(27) Place and hold signal test switch on analyzer in increase position. Check that output meter indicates between 83 and 130. Release switch.

(28) Place switch on analyzer in decrease position.

(29) Adjust amplifier input knob until input meter indicates 0.8 volts. Check that output meter indicates within black band and that manual control and indicating lever moves towards decrease position.

(30) Place and hold signal test switch on analyzer in decrease position. Check that output meter indicates between 83 and 130. Release switch.

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(31) When manual control and indicating lever is at end of travel, check that output meter indicates below 50.

(32) Place switch in amplifier ground depress signal (3V) position.

(33) Close left and right ground control relay circuit breakers located on miscellaneous ac bus section of EPC circuit breaker panel.

(34) Place amplifier input knob in full counterclockwise position.

(35) Place cabin air outflow valve manual control and indicating lever in midposition in automatic mode. Check that output meter indicates within black band and that lever moves towards decrease position.

(36) With lever moving, adjust amplifier input knob on analyzer until output meter indicates lowest value and lever stops. Check that input meter indicates between 1.2 and 1.8.

(37) Open cabin pressure control circuit breaker located on heat, vent, and ice protection ac section of EPC circuit breaker panel.

(38) Disconnect analyzer plugs and connect cabin pressure controller amplifier electrical connector to amplifier.

(39) Close cabin pressure control circuit breaker located on heat, vent, and ice protection ac section of EPC circuit breaker panel.

F. Test Cabin Pressure Control System Using Analyzer With Cabin Pressurized

(1) Move cabin air outflow valve manual control and indicating lever from full increase to full decrease position in manual mode, to check for freedom of movement of cabin air outflow valve and manual control cable system.

<u>NOTE</u>: The cabin pressure control system is in automatic mode when the cabin air outflow valve manual control and indicating lever knob is parallel with the control quadrant. The cabin pressure control system is in manual mode when the manual control and indicating lever knob is extended and turned 90 degrees, allowing the lever to be locked in any position over the operating range.

(2) Open cabin pressure control circuit breaker located on heat, vent, and ice protection ac section of EPC circuit breaker panel.

(3) Disconnect cabin pressure controller amplifier electrical connector (see Wiring Diagram Manual).

(4) Connect analyzer plugs to amplifier and amplifier electrical connector. Connect analyzer ground terminal to airplane bare metal ground.

(5) Open left and right ground control relay circuit breakers located on miscellaneous ac bus section of EPC circuit breaker panel.

<u>WARNING</u>: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(6) Place switch on analyzer in system (3V or 10V) position.

<u>NOTE</u>: When the selector switch is in system (3V or 10V) position, cabin pressure control system operation is controlled by airplane components. The analyzer input and output meters indicate system input and output voltages.

(7) Close cabin pressure control circuit breaker located on heat, vent, and ice protection ac section of EPC circuit breaker panel.

(8) Check that ac power lights on analyzer panel come on.

NOTE: If lights do not come on, check airplane power circuits (see Wiring Diagram Manual).

(9) Place airplane voltage selector switch on systems engineer's control panel to ac position, and check that airplane ac voltmeter indicates 115 (±3) vac.

(10) Place and hold meter select switch on analyzer panel. Check that analyzer input meter indicates 1.3 (±0.1) volts and output meter indicates 50 (±4) volts. Release switch.

NOTE: If input and output meter indications are not within limits, analyzer should be calibrated.

(11) Manually pressurize cabin. Check that input meter on analyzer indicates below 2.8 volts while cabin pressure is below 8.5 psi.

(12) When cabin differential pressure is above 8.5 psi, place and hold meter select on analyzer in pressure control differential (10V) position, and check that input meter indicates between 3.0 and 6.5 volts. Release switch.

WARNING: DO NOT EXCEED 8.5 PSI CABIN-TO-AMBIENT DIFFERENTIAL PRESSURE WHILE PERFORMING FOLLOWING STEPS.

(13) Place switch on analyzer in pressure control (3V or 10V) position.

(14) Set control knob on cabin pressure controller to minimum position.

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(15) Push in altitude selector knob and set pointer on altitude scale to -1000 feet and then to +1000 feet from cabin altitude. Check that input meter on analyzer indicates within the minimum rate band in both settings.

(16) Set rate control knob to maximum position.

(17) Set pointer on altitude scale to -1000 feet and then to +1000 feet from cabin altitude. Check that input meter indicates within the maximum rate band at both settings.

(18) With rate control knob in any position, adjust altitude selector until input meter indicates within null band. Check that altitude pointer is ±200 feet from cabin altitude.

(19) Place switch on analyzer in rate control (3V) position. Check that input meter indicates within null band.

input meter indicates within null band.

(20) Manually depressurize and then pressurize cabin while maintaining input meter indication within minimum rate band. Check that rate-of-climb indicator indicates between 0 and 275 feet per minute while pressurizing and depressurizing cabin.

(21) Manually depressurize and then pressurize cabin maintaining input meter indication within maximum rate band. Check that rate-of-climb indicator indicates over 500 feet per minute while pressurizing and depressurizing cabin.

(22) Close left and right ground control relay circuit breakers located on miscellaneous ac bus section of EPC circuit breaker panel.

(23) Open cabin pressure control circuit breaker located on heat, vent, and ice protection ac section of EPC circuit breaker panel.

(24) Disconnect analyzer, and connect airplane electrical connector to amplifier.

(25) Close cabin pressure control circuit breaker located on heat, vent,and ice protection ac section on EPC circuit breaker panel.

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CABIN PRESSURE CONTROLLER - MAINTENANCE PRACTICES

1. General

A. The cabin pressure controller is installed on the systems engineer's control panel in the flight compartment.

B. Access to the cabin pressure controller is through the systems engineer's control panel.

2. Removal/Installation Cabin Pressure Controller

A. Remove Cabin Pressure Controller

(1) Open cabin pressure control circuit breaker, located on heat, vent, and ice protection ac section of EPC circuit breaker panel.

(2) Open systems engineer's panel red light circuit breaker, located on lighting ac section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER.

(3) Loosen fillister-head screws on clamp that secures controller to systems engineer's control panel and remove controller from panel

(4) Disconnect electrical connector.

(5) Disconnect sense line.

(6) Remove fitting from controller. Discard O-ring.

B. Install Cabin Pressure Controller

(1) Make certain that cabin pressure control circuit breaker, located on heat, vent, and ice protection ac section of EPC circuit breaker panel, is open.

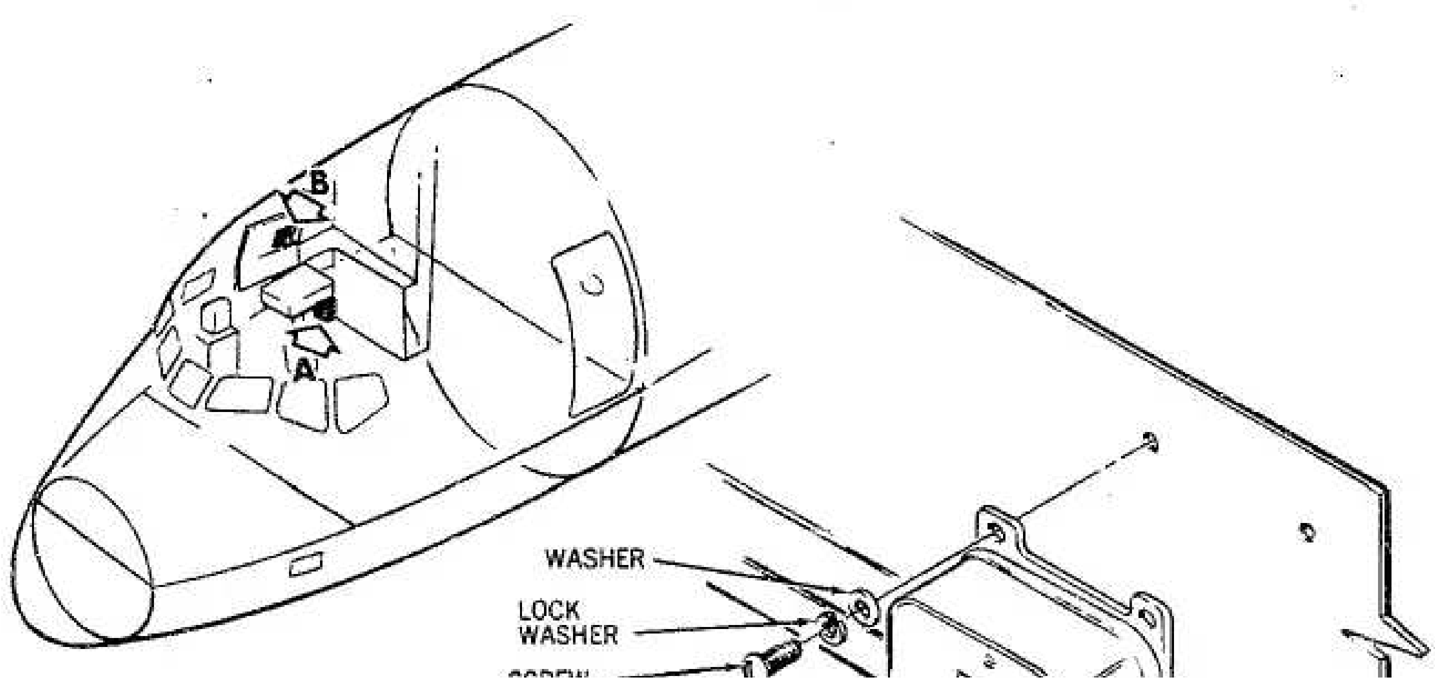
(2) Make certain that systems engineer's panel red light circuit breaker, located on lighting ac section of EPC circuit breaker panel, is open.

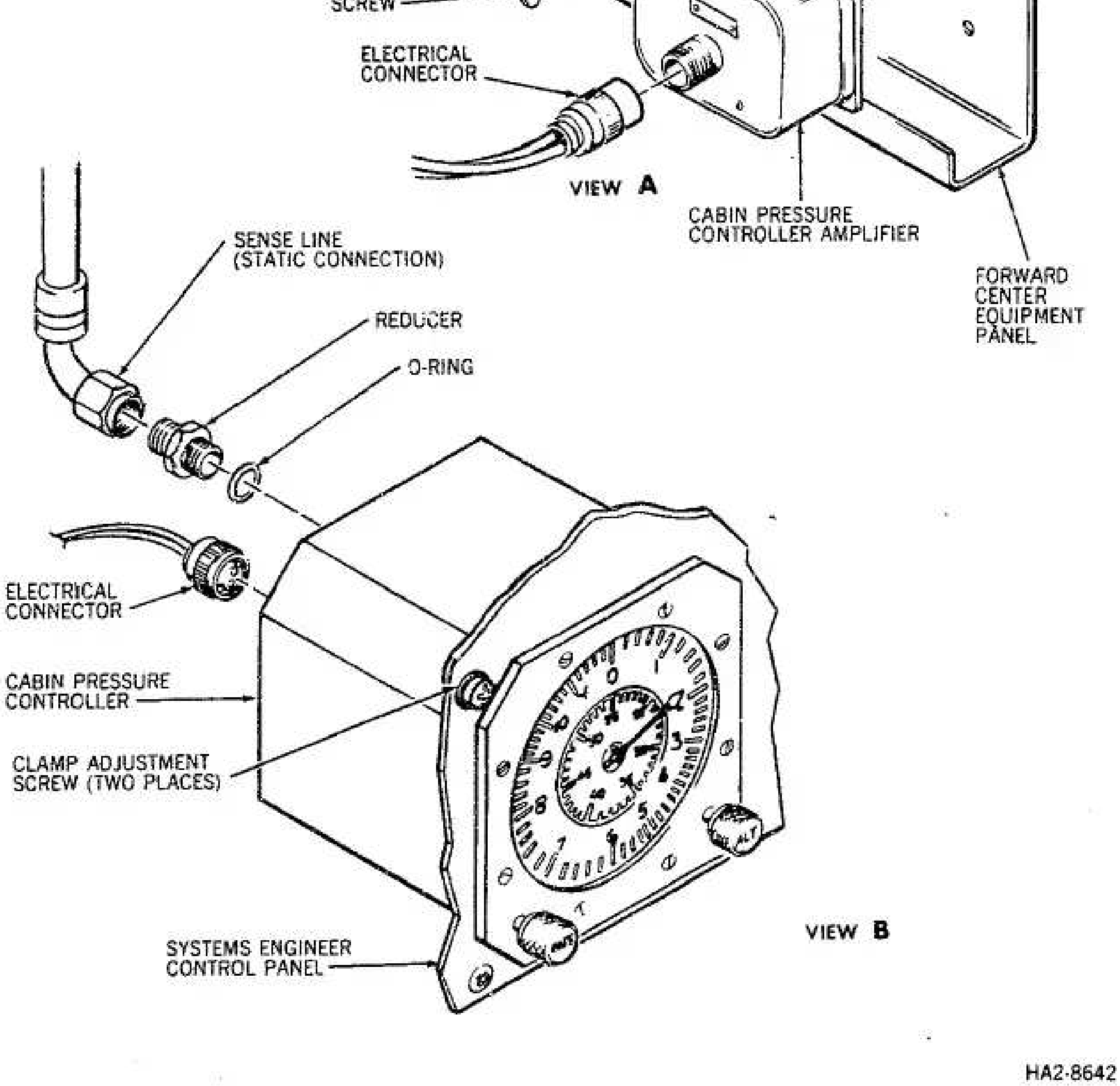
(3) Using new O-ring, install fitting in controller.

(4) Connect electrical connector.

(5) Connect sense line.

(6) Install controller and tighten fillister-head screws.





Cabin Pressure Controller -- Installation
Figure 201

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(7) Close cabin pressure control circuit breaker, located on heat, vent, and ice protection ac section of EPC circuit breaker panel.

(8) Close systems engineer's panel red light circuit breaker, located on lighting ac section of EPC circuit breaker panel.

(9) Test cabin pressure controller by performing cabin pressure control system test (see 21-31-0, Maintenance Practices).

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CABIN PRESSURE CONTROLLER AMPLIFIER - MAINTENANCE PRACTICES

1. General

   A. The cabin pressure control amplifier is installed on the forward center equipment panel at the electrical power center in the flight compartment.

   B. Access to the cabin pressure controller amplifier is through the forward center equipment panel.

2. Removal/Installation Cabin Pressure Controller Amplifier

A. Remove Cabin Pressure Controller Amplifier

(1) Open cabin pressure control circuit breaker, located on heat, vent, and ice protection ac section of EPC circuit breaker panel.

<u>WARNING</u>: TAG AND SAFETY CIRCUIT BREAKER.

(2) Disconnect electrical connector.

(3) Remove amplifier.

B. Install Cabin Pressure Controller Amplifier

(1) Make certain that cabin pressure control circuit breaker, located on heat, vent, and ice protection ac section of EPC circuit breaker panel, is open.

(2) Install amplifier.

(3) Connect electrical connector.

(4) Close cabin pressure control circuit breaker, located on heat, vent, and ice protection ac section of EPC circuit breaker panel.

(5) Test cabin pressure controller amplifier by performing cabin pressure control system test (see 21-31-0, Maintenance Practices).

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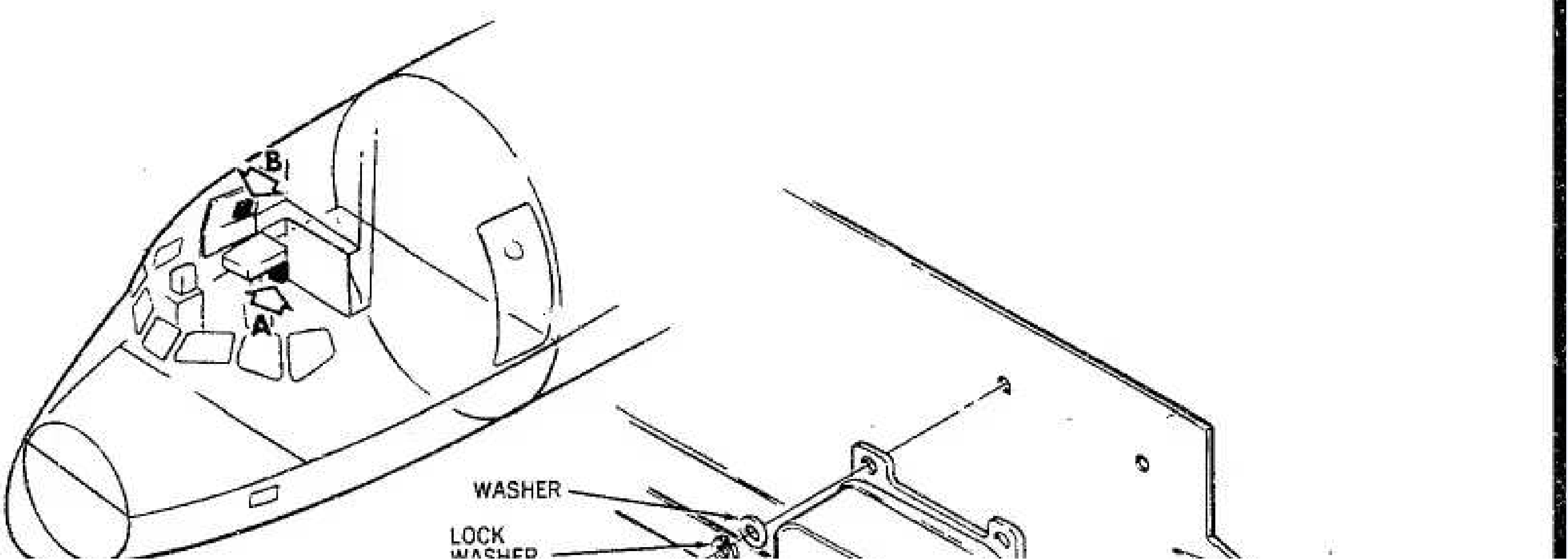

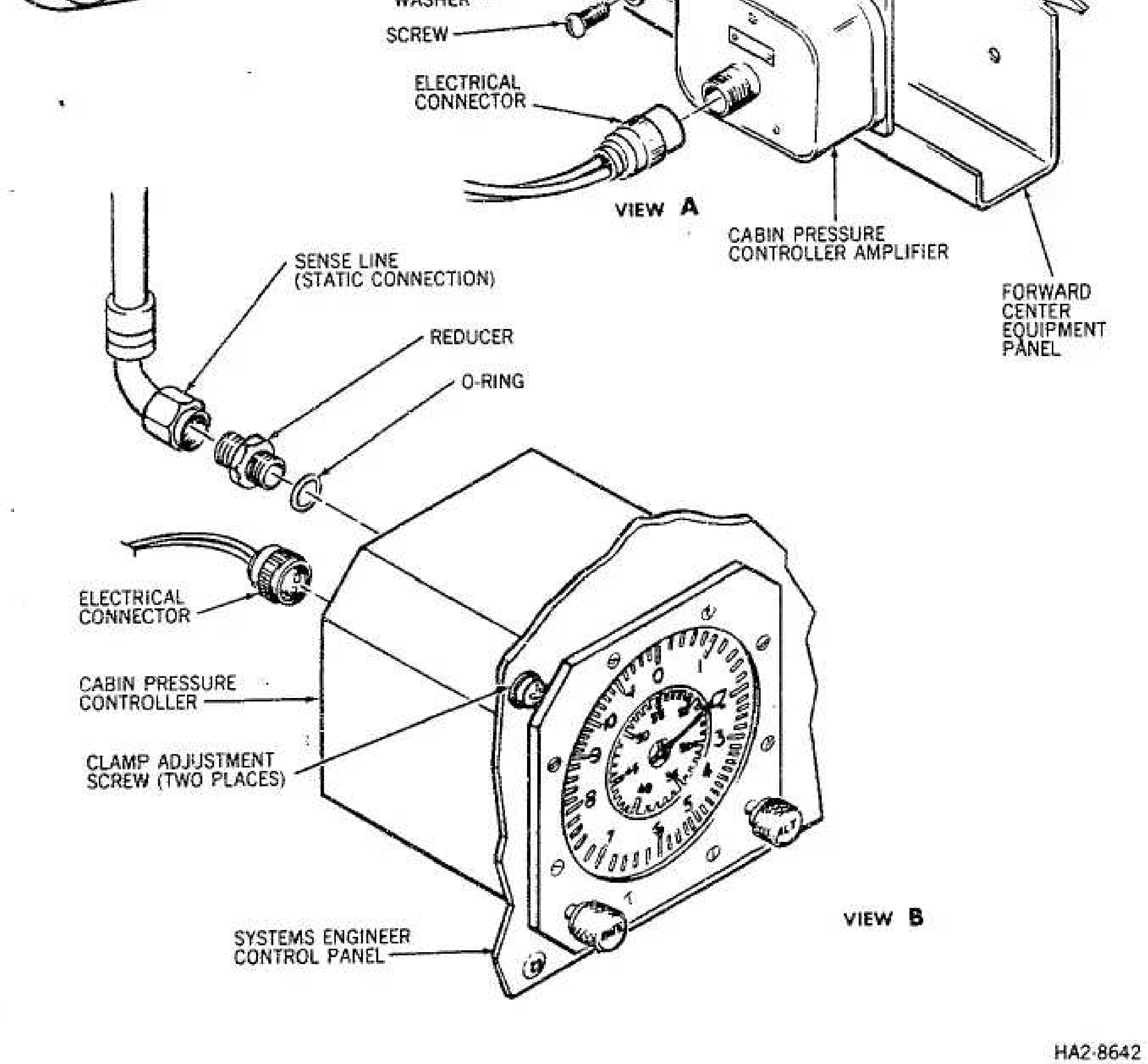

Cabin Pressure Controller Amplifier -- Installation
Figure 201

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CABIN PRESSURE SAFETY VALVE - MAINTENANCE PRACTICES

1. General

   A. A cabin pressure safety valve is located on each side of the lower aft fuselage, and are installed in the fuselage structure on the lower surface of the tail section.

   B. Access to the valves is through an access door in the aft bulkhead of the aft cargo compartment.

   C. Removal and installation procedures for each of the valves are identical.

2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Plastic bristle brush			Remove sealant from attach holes
B	Nonmetallic scraper		Local	Remove sealant from fuselage
C	Clean cloths			General cleaning
D	Sealant	EC-1608	Minnesota Mining & Mfg. Co.	Seal valve and shim
E	Solvent	No. 14	Douglas Aircraft Co., Inc.	Remove sealant from fuselage
F	Calibrated vacuum source	2000 or 2024	Burton Instrument Co.	Reduce pressure at static port of safety valve
G	Static port test adapter	2078	Burton Instrument Co.	Connect calibrated vacuum source to safety valve static port
H	Calibrated rate-of-climb indicator			Compare with airplane rate-of-climb indicator

Item	Name	Number	Manufacturer	Use
I	Calibrated altimeter			Compare with airplane cabin altitude and differential pressure indicator
J	Calibrated differential pressure gage			Cabin pressurization

3. Servicing Cabin Pressure Safety Valve

A. Servicing the cabin pressure safety valve entails removing and cleaning the filter. The filter can be removed without removing the valve from the airplane.

4. Removal/Installation Cabin Pressure Safety Valve

A. Remove Cabin Pressure Safety Valve

(1) Disconnect sense line from valve.

(2) Remove valve, shim, and ring. Note locations of different length attach screws to aid installation.

B. Install Cabin Pressure Safety Valve

(1) Remove sealant from fuselage with nonmetallic scraper. Wipe with cloths dampened with solvent. Use small plastic bristle brush to clean sealant from attach holes and ring.

(2) Prepare shims, ensuring edges of valve are flush with fuselage.

(3) Apply sealant to fuselage and valve faying surface.

(4) Install valve, shim, and ring.

NOTE: Safety valve attach screws, installed at each location, must be of correct length.

(5) Connect sense line to valve.

(6) Leak check cabin pressure safety valve (see paragraph 5).

(7) Test cabin pressure safety valve (see paragraph 6).

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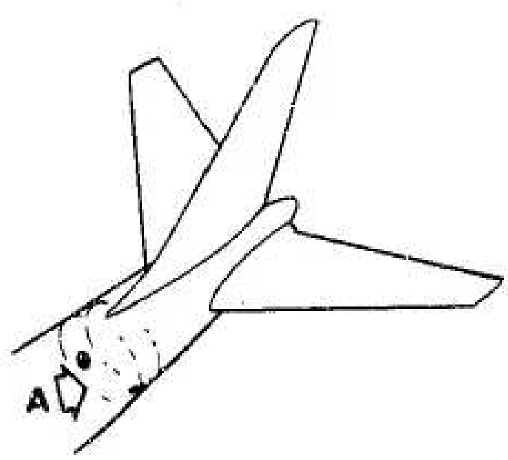

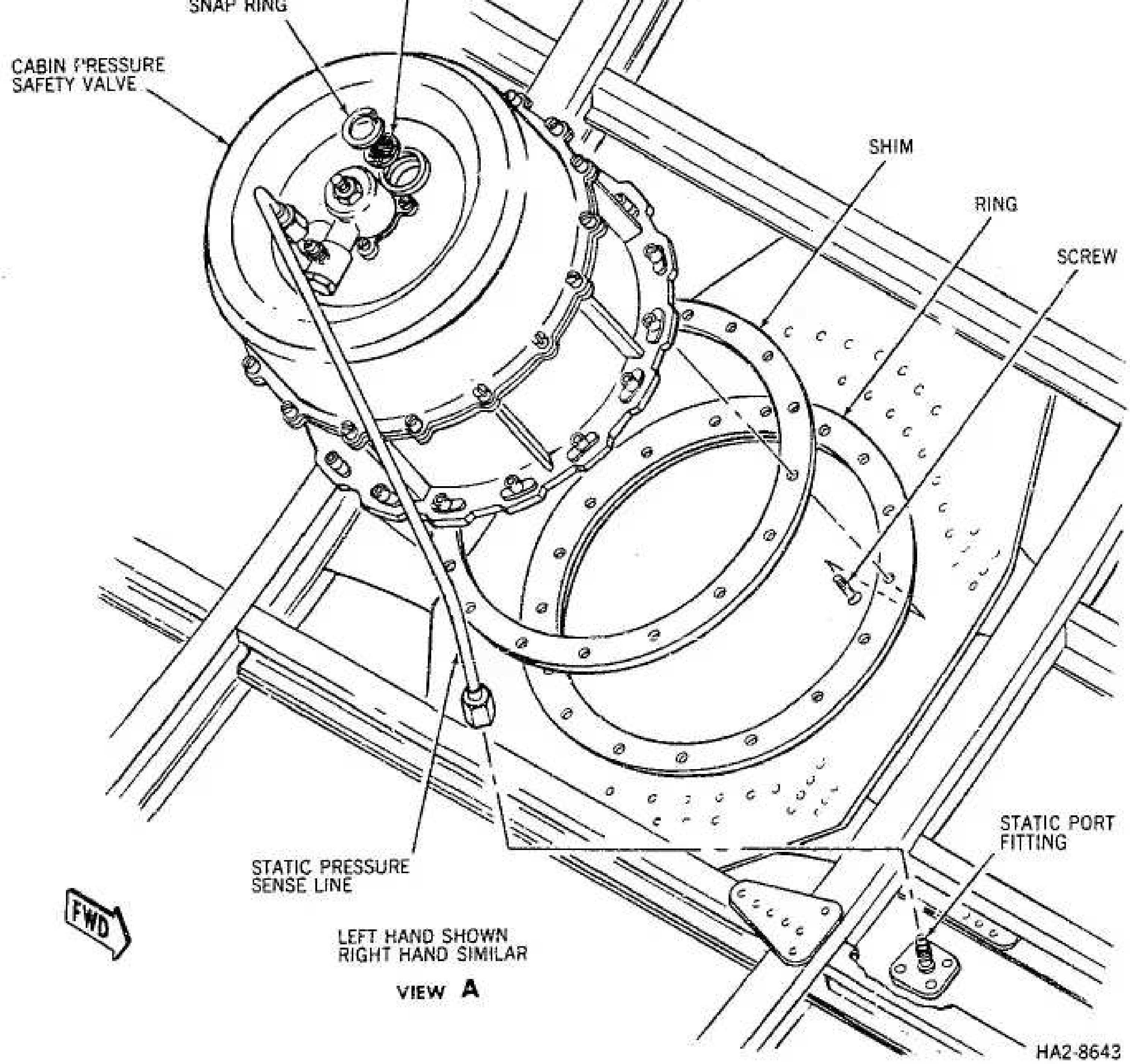

Cabin Pressure Safety Valve -- Installation
Figure 201

5. Adjustment/Test Cabin Pressure Safety Valve

A. Test Cabin Pressure Safety Valve

(1) Close airplane doors and windows.

NOTE: Do not cover drain holes and venturis which are normally open.

(2) Position switches and controls as follows:

Control	Position
Left air conditioning pack switch	Off

Right air conditioning pack switch	Off
Recirculating fan switch	Off

NOTE: The cabin pressure control system is in the automatic mode when the cabin air outflow valve manual control and indicating lever knob is parallel with the control quadrant. The cabin pressure control system is in the manual mode when the manual control and indicating lever knob is extended and turned 90 degrees, allowing the lever to be locked in any position over the operating range.

(3) Pressurize airplane pneumatic manifold (see Chapter 36).

(4) Start left or right air conditioning pack (see 21-00, Description and Operation).

(5) Install vacuum cup of static port test adapter over static port of cabin pressure safety valve to be tested. Apply differential pressure of 6.85 psi. Maintain for remainder of test.

(6) Pressurize cabin to 8.6 psi cabin-to-static port pressure differential at a comfortable rate, by slowly pushing cabin air outflow valve manual control and indicating lever forward, toward increase position.

(7) Check that flappers of safety valve do not open at 8.6 psi differential pressure, but some air may be exhausting.

(8) Continue to push cabin air outflow valve manual control and indicating lever toward increase position. Cabin should pressurize at a stabilized descent not greater than 500 feet per minute.

(9) Check that flappers of safety valve open, and cabin-to-static port differential pressure attains a maximum of 9.1 psi, with manual control and indicating lever in full increase position.

(10) Stop air conditioning pack.

(11) Place and lock cabin air outflow valve manual control and indicating lever in full decrease position.

(12) Reduce static port differential pressure to 0 psi. Remove adapter.

(13) Depressurize airplane manifold.

(14) Place cabin air outflow valve manual control and indicating lever in automatic mode.

6. Inspection/Check Cabin Pressure Safety Valve

A. Leak Check Cabin Pressure Safety Valve

(1) Pressurize cabin (see 21-31-0).

(2) Check cabin pressure safety valve installation for leaks by sound and feel.

(3) Depressurize cabin.

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CABIN ALTITUDE AND DIFFERENTIAL PRESSURE INDICATOR -

MAINTENANCE PRACTICES

1. General

A. The cabin altitude and differential pressure indicator is installed on the systems engineer's control panel in the flight compartment.

B. Access to the indicator is through the systems engineer's control panel.

2. Removal/Installation Cabin Altitude and Differential Pressure Indicator

A. Remove Indicator

(1) Open systems engineer's panel red light circuit breaker, located on lighting ac section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER.

(2) Loosen fillister-head screws on clamp that secures indicator to systems engineer's control panel.

(3) Disconnect electrical connector.

(4) Disconnect sense line.

(5) Remove indicator from systems engineer's control panel.

(6) Remove fitting. Discard O-ring.

B. Install Indicator

(1) Make certain that systems engineer's panel red light circuit breaker, located on lighting ac section of EPC circuit breaker panel, is open.

(2) Using new O-ring, install fitting in indicator.

(3) Connect electrical connector.

(4) Connect sense line.

(5) Install indicator and tighten fillister-head screws.

(6) Close systems engineer's panel red light circuit breaker, located on lighting ac section of EPC circuit breaker panel.

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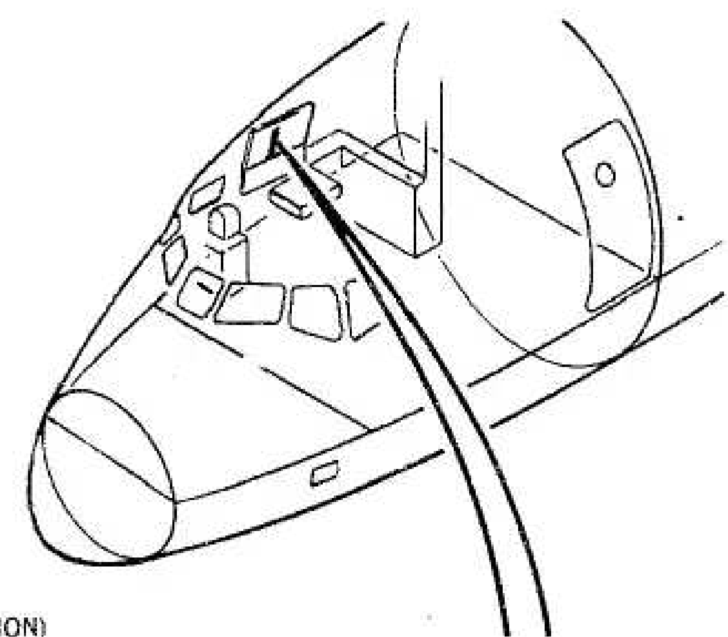
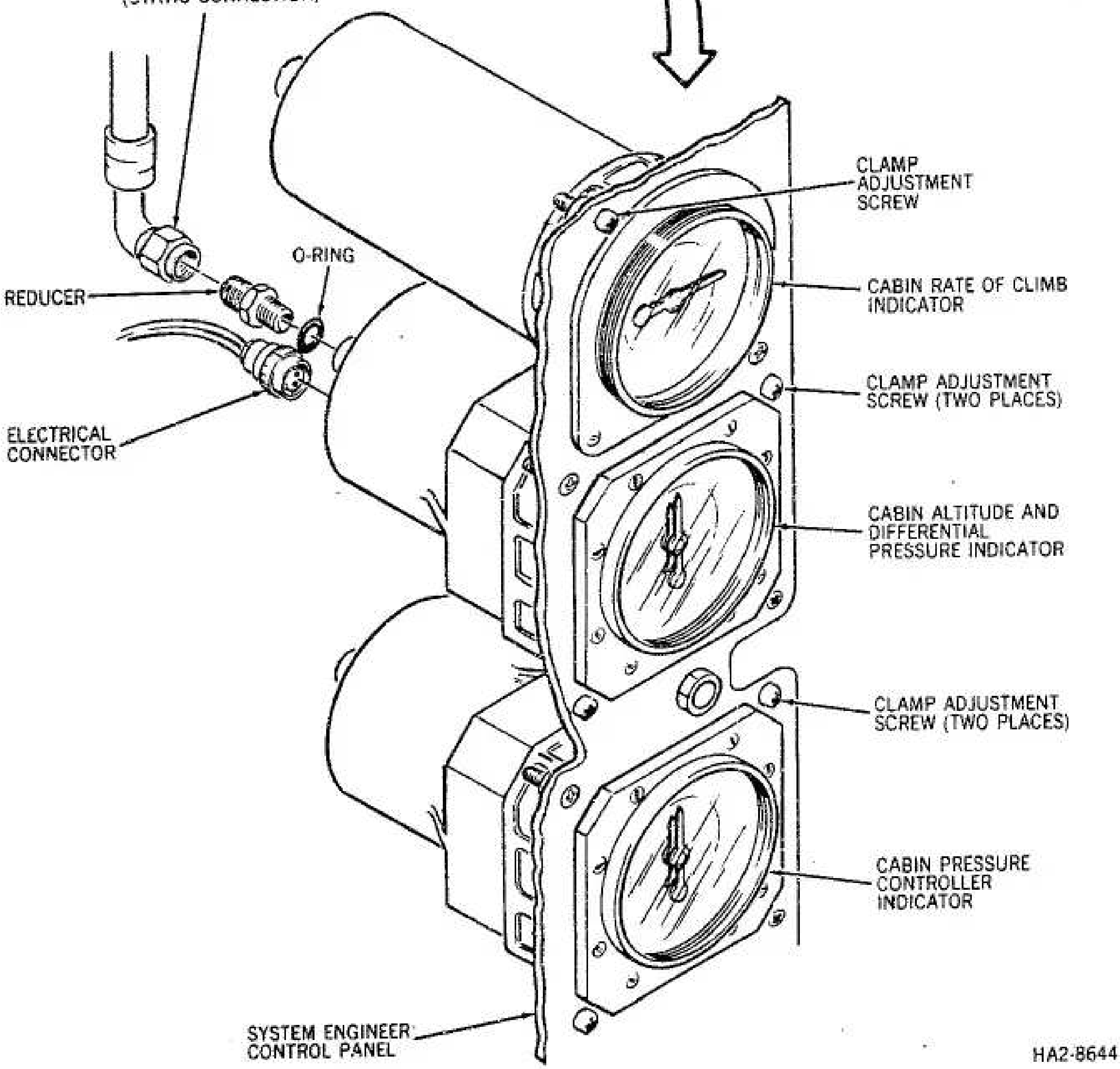


SENSE LINE
(STATIC CONNECTION)



Cabin Altitude and Differential Pressure
Indicator -- Installation
Figure 201

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CABIN RATE-OF-CLIMB INDICATOR - MAINTENANCE PRACTICES

1. General

A. The cabin rate-of-climb indicator is installed on the systems engineer's control panel in the flight compartment.

B. Access to the indicator is through the systems engineer's control panel.

2. Removal/Installation Cabin Rate-Of-Climb Indicator

A. Remove Indicator

(1) Open systems engineer's panel red light circuit breaker, located on lighting ac section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER.

(2) Loosen fillister-head screws on clamp that secures indicator to systems engineer's panel.

(3) Disconnect electrical connector.

(4) Remove indicator from systems engineer's control panel.

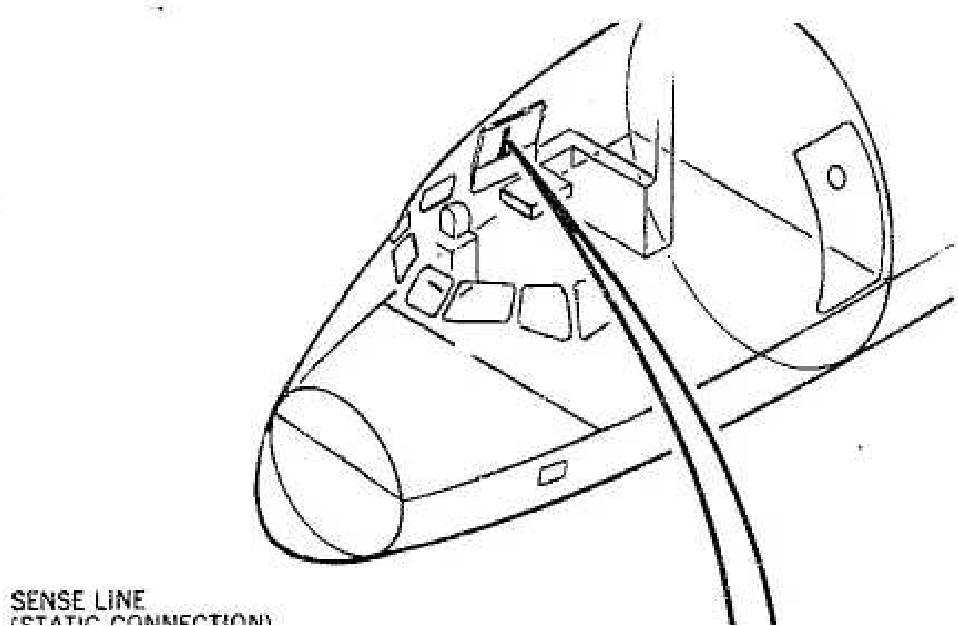
B. Install Indicator

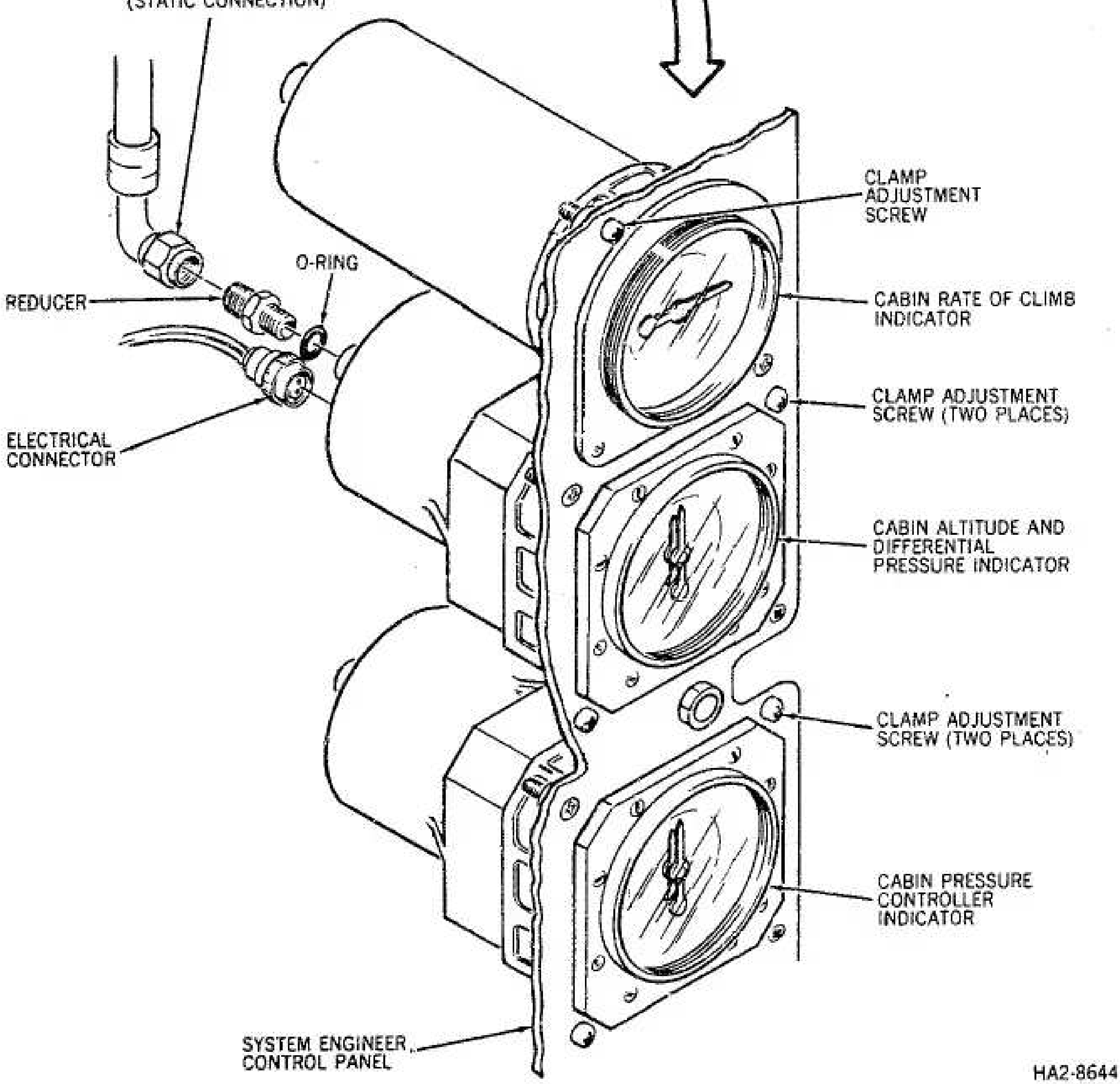
(1) Make certain that systems engineer's panel red light circuit breaker, located on lighting ac section of EPC circuit breaker panel, is open.

(2) Connect electrical connector.

(3) Install indicator and tighten fillister-head screws.

(4) Close systems engineer panel red light circuit breaker, located on lighting ac section of EPC circuit breaker panel.





Cabin Rate-Of-Climb Indicator -- Installation
Figure 201

COOLING - DESCRIPTION AND OPERATION

1. General

A. The cooling components of this airplane have been segregated into 2 main groups for coherent descript'on of equipment and system operation. The two groups are the cooling system and radio rack cooling.

2. Description

A. The actual cooling function of the conditioned air supplied to the occupied areas of the airplane is performed by the cooling systems, one for each air

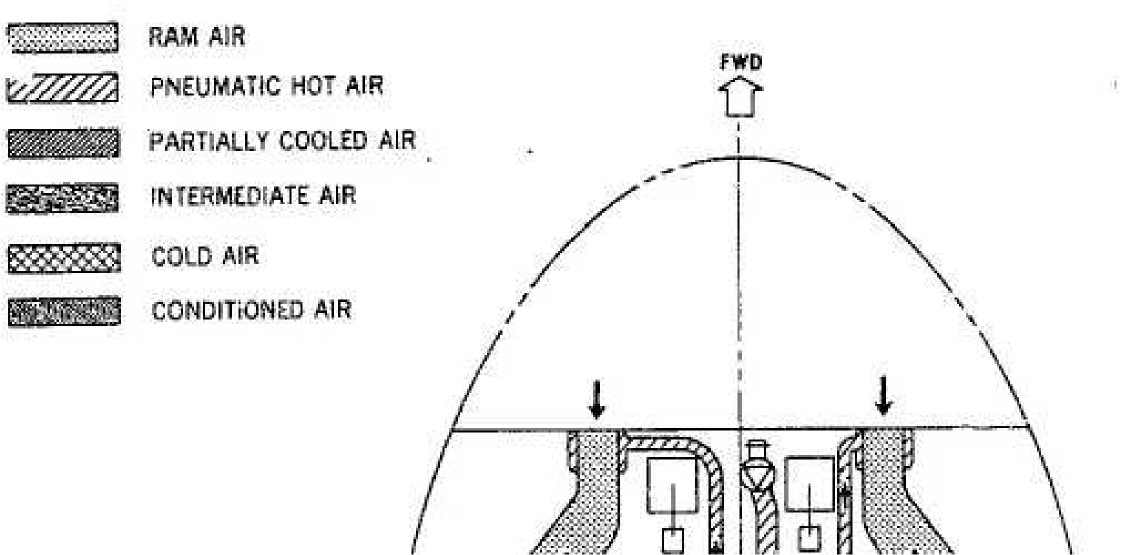
conditioning system. The cooling system is divided into two subsystems: Cooling Packs and Ram Air System. Cooling packs describes the path of air being cooled and the equipment used for cooling it. Ram air system describes the system and its control which employs outside air as a cooling medium for the cooling packs. Refer to 21-55-0, Cooling Packs and 21-56-0, Ram Air System.

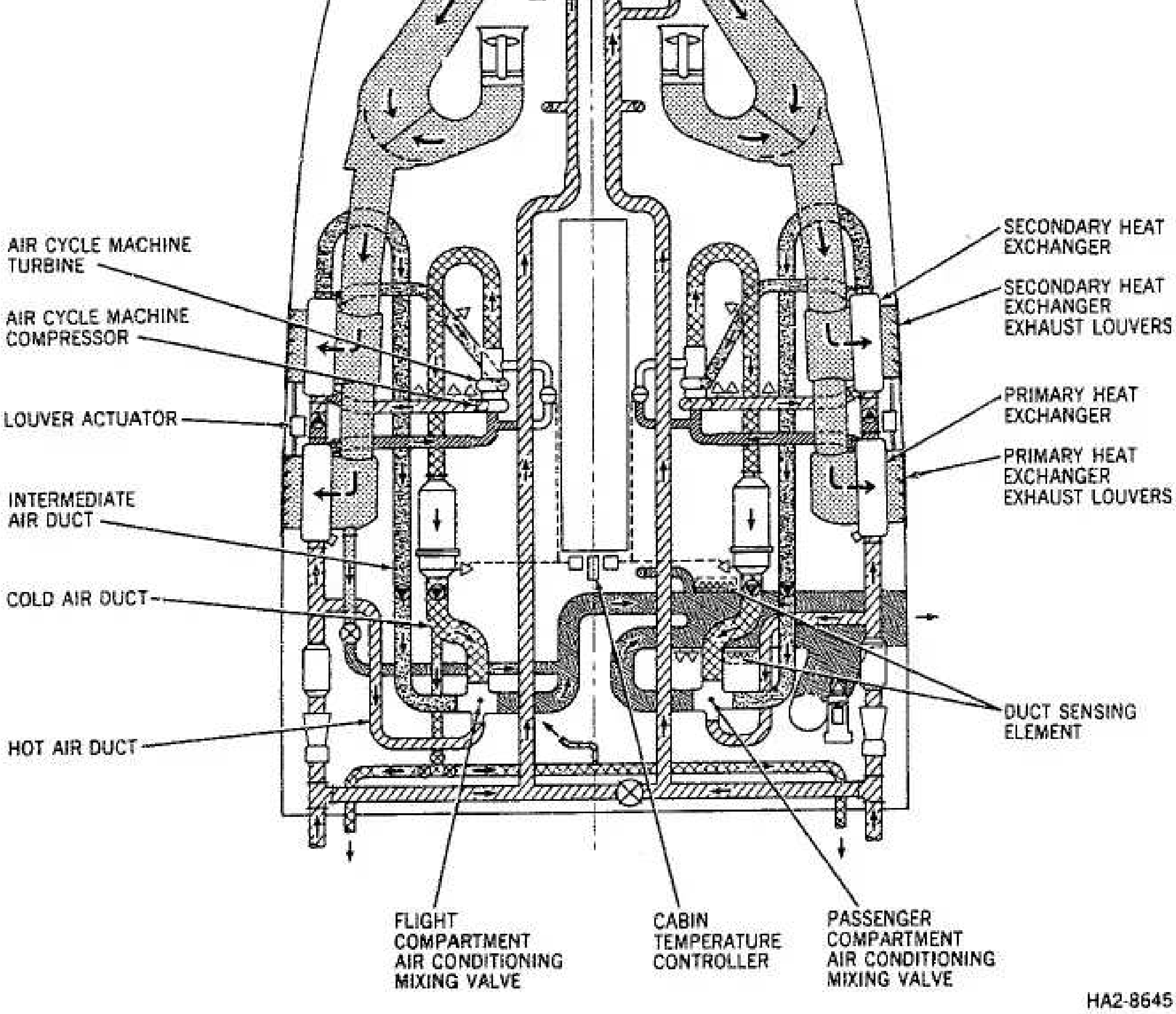
B. The radio rack cooling system (see 21-53-0) uses flight compartment exhaust air to cool the electrical and electronic equipment, and heat the forward cargo compartment. Equipment cooling is maintained automatically, but a rack overheat caution light on the systems engineer control panels warns the operator when insufficient cooling airflow is available for equipment cooling. The forward cargo compartment temperature is maintained between 60° and 75°F.

3. Operation

A. Cooling includes that portion of the air conditioning system which reduces the temperature of air received from the pneumatic system enough to meet any cooling requirement of the air conditioning system.

B. Air from the pneumatic system is divided such that part of the air is passed through the cooling system with the remainder passing on to the mix valves. The cooled air is then mixed with the bypassed air to supply properly conditioned air to the distribution system. Two mix valves, one for each cooling pack, proportion the air (see Figure 1).





Temperature Control -- Mechanical Schematic
Figure 1

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C. Cooling packs supply the cold air needed for mixture with the hot compressed engine bleed air to provide a selected temperature in the flight and passenger compartment. Approximately 370°F air is received into the air conditioning system at a relatively constant 88 pounds per minute flow. See Chapter 36, Pneumatics. This air must be cooled a variable amount depending upon environmental conditions of the passenger compartment. The temperature air are supplied by the same duct,
and airflow to the compartment is relatively constant, the mix valves not only regulate the quantity of cold air being supplied by the packs, but in regulating quantity, also influence temperature drop across the cooling packs. A 35 degree control system bypasses warm air around the turbine to mix with cold air from the turbine to prevent freezing in the water separator. As a result cold air at the mix valve is never below freezing.

E. Another system which has an influence on the cooling ability of the cooling packs is the ram air system. Although this system is not actually a part

packs is the ram air system. Although this system is not actually a part of the packs it supplies a cooling medium for the heat exchangers and must necessarily be considered in a discussion of the cooling packs. The ram air system may be regulated to cut down ram airflow when maximum cooling is not required.

F. The mix valves may vary from full cold to hot depending on cabin requirements and the ram air system may be set at considerably less than maximum airflow. In describing how the cooling packs operate however, it is convenient to consider the mix valves in the full cold position, hot valve closed-cold valve open, and the ram air louver doors full open.

G. There are two cooling packs on each airplane. The packs are virtually identical and are located on either side of the airplane centerline in the areas at the sides of the nosewheel area. The left pack is considered to supply the flight compartment and the right pack the passenger compartment. The packs operate in parallel however and feed to a common manifold. During normal operation the flight compartment utilizes only approximately twenty-four percent of the left pack supply with the balance going to the passenger compartment. Either pack operating alone is capable of maintaining acceptable temperatures when necessary. Figure 2 locates the cooling pack and ram air system equipment.

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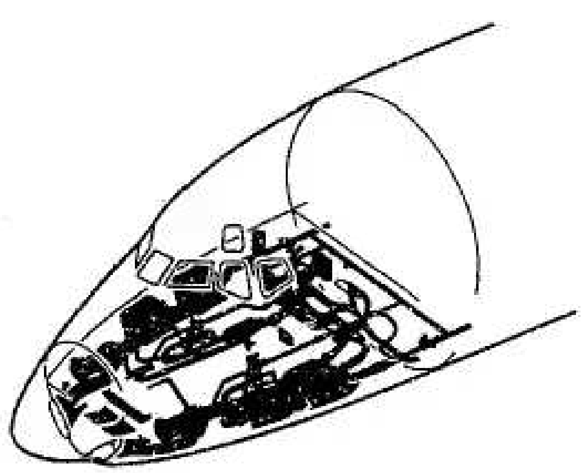

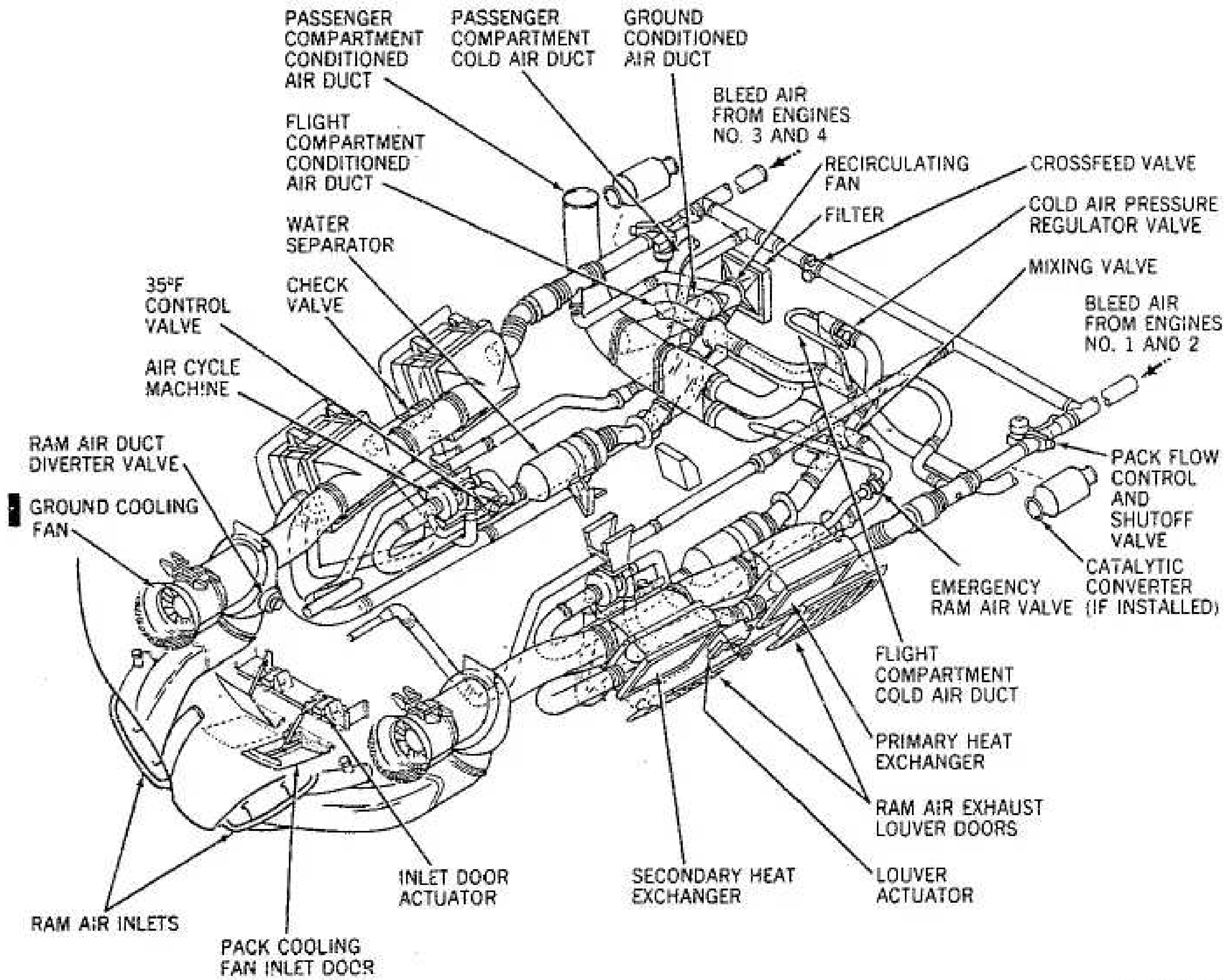

Air Conditioning Equipment Location
Figure 2

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COOLING SYSTEM - TROUBLE SHOOTING

1. General

A. The logical sequence of trouble shooting can be followed by referring to the electrical and mechanical schematics in the Description and Operation section, but when performing electrical circuit or component checks at specific pins or connectors, reference should be made to the Wiring Diagram Manual. If a particular item is suspect, perform the applicable component test given in the Maintenance Practices or Adjustment/Test section.

B. While performing trouble shooting procedures on the cooling system, position controls as indicated in the air conditioning system starting procedures given in 21-00, Description and Operation, except for those controls necessary to operate equipment being checked. The above section also con-

necessary to operate equipment being checked. The above section also contains a complete list of system circuit breakers which should normally be closed. Power must always be applied to the airplane electrical buses during trouble shooting unless specifically qualified as otherwise in the procedure.

C. Trouble shooting the cooling portion of the air conditioning system involves both cooling packs and the ram air system. A clear understanding of how the different components are interrelated as well as the function of each is needed to quickly locate and correct difficulties in either system.

D. Grouping the individual components according to function aids in locating a defective component. The water separator, 35° control sensor and control, and 35° control valve are functionally related. Another grouping includes the heat exchangers, air cycle machine, ram air system, compressor discharge and turbine inlet overheat thermal switches, and the pack temperature bulb.

2. Water Separator - 35° Control System

A. Trouble in the water separator - 35° control system may be recognized by moisture or fog in the cabin, a pounding noise from the water separator bypass valve opening and closing, or by the lack of water emerging from the drain when running air conditioning on the ground. Water separator difficulties may be caused by water freezing on the condenser bag as a result of a faulty sensor or 35° control valve, or the 35° control, or a dirty condenser bag.

B. Built-in test equipment on 35° controls provide a method for checking electrical operation of 35° control system and if there are problems will isolate the faulty component. Test instructions are printed above the control unit.

3. Cooling Equipment

A. Thermal switches are located in key spots to prevent failure of a single unit in the system from harming other cooling pack equipment. Sensors, trouble lights, and indicators are provided to call attention to abnormal conditions. When trouble shooting, it is often helpful to consider the indicator reading at time of failure to locate the failed component. For example, either the air cycle machine (ACM) compressor discharge overheat, the ACM turbine inlet overheat, or the 240°F duct overheat switch will cause pack shutdown.

B. When either thermal switch closes, a circuit is completed to close the pack flow control and shutoff valve. Should the pack trip off at a time when pack temperature is much less than the overheat trip value of 390°F (198°C), proper cooling is not being accomplished by the secondary heat exchanger and trip-off results from the turbine inlet overheat switch.

If pack temperature indicator reads high temperature or is approaching it, trip off is a result of overheat.

C. For turbine inlet overheat trip-off, remove inspection doors on secondary heat exchanger plenum and examine for any obstruction to flow at the secondary heat exchanger. If no obstruction, check turbine inlet overheat switch.

D. Pack trip-off from overheat may result from any one of several failures. In each case however, indicator readings will give a clue as to where the difficulty exists. Pack overheat will result either from restriction of air flow through the ram air system or an over abundance of air supply from the pneumatic system. The flow control and shutoff valve in the pneumatic system is electrically controlled and actuated by pneumatic air pressure. Although a bad valve may cause either more or less flow than nominal, a failure may also cause the valve to move to full open. Should air supply to the packs be greater than normal, pack temperature will rise although not necessarily enough to cause the packs to trip off. The increase in flow will cause a corresponding increase through air conditioning ducts
R which may be reported as abnormal duct noise. If the valve fails in the
R full open position, packs may trip off due to overheat. At such time the increase in airflow to the cabin will be so great that it cannot escape notice. For trouble shooting the pneumatic supply system refer to Chapter 36, Pneumatic.

E. If the pack trips off from overheat but without excess air supply, the ram air system should be suspected. Check that ram air inlet and exhaust louver doors are open and that pack cooling and ram air diverter valves open easily. Should foreign objects such as paper or cloth be ingested into the ram air system, they could also restrict flow through the ram air system. Inspection doors are provided in the ram air plenums of each heat exchanger for checking inside the ducts. If packs have tripped off without excessive pack temperatures being recorded, the thermal switches may be defective and should be checked per adjustment/test procedure.

4. Trouble Shooting

Possible Causes	Isolation Procedure	Correction

A. FOG OR HIGH HUMIDITY IN CABIN AND/OR POUNDING NOISE HEARD THROUGH DISTRIBUTION SYSTEM

WARNING: BEFORE DISCONNECTING ELECTRICAL CONNECTORS TO PERFORM ANY ISOLATION PROCEDURE, OPEN APPLICABLE CIRCUIT BREAKERS TO MAKE SURE ELECTRICAL CIRCUITS ARE DEENERGIZED. CLOSE CIRCUIT BREAKERS AFTER CONNECTORS ARE REMOVED, AS REQUIRED, TO PERFORM ISOLATION PROCEDURE.

(1)	Water separator coalescer is clogged	Pressurize pneumatic system ard operate each system separately to determine faulty system.	Replace water separator coalescer. During replacement, check that by-pass valve is not open or binding. Check for clogged drain.
(2)	Defective 35° control valve	Remove electrical connector from 35° control valve and check for 115V AC close signal at pin 2. (If airplane is cold soaked, 35°F or below, check for 115V AC open signal at pin 1.)	If control valve is not in position as calle for by input signal, replace 35° control valve. If power is not present at connector, proceed to step (3). If power is present at connector, proceed to step (4).
(3)	Circuit breakers open or defective	Inspect for open circuit breaker. Deengergize electrical buses and perform continuity check of breaker.	Close circuit breakers if open. Replace circuit breakers if defective.

	Possible Causes	Isolation Procedure	Correction
A.	FOG OR HIGH HUMIDITY IN CABIN AND/OR POUNDING NOISE HEARD THROUGH DISTRIBUTION SYSTEM (CONTINUED)		
(4)	Defective 35° control sensor	Remov- plug from 35° sensor, remove sensor and reinstall plug on sensor. Dependent upon ambient temperature apply heat or ice to sensor connector. Heat is applied check for	If power is not present at connector, replace sensor and rerun ice or heat test.

heat is applied check for close signal at pin 2 of control valve connector.

Ice is applied check for open signal at pin 1 of control valve connector.

(5) Defective 35° control	Perform step (4)	If power is still missing from pins 1 or 2 replace 35° control.
(6) Faulty airplane wiring	Perform continuity and resistance checks of airplane wiring (see Wiring Diagram Manual).	Replace or repair wiring as required.

B. CABIN WILL NOT COOL SUFFICIENTLY BY EITHER THE MANUAL OR AUTOMATIC TEMPERATURE CONTROL SYSTEM

WARNING: BEFORE DISCONNECTING ELECTRICAL CONNECTORS TO PERFORM ANY ISOLATION PROCEDURE, OPEN APPLICABLE CIRCUIT BREAKERS TO MAKE SURE ELECTRICAL CIRCUITS ARE DEENERGIZED. CLOSE CIRCUIT BREAKERS AFTER CONNECTORS ARE REMOVED, AS REQUIRED, TO PERFORM ISOLATION PROCEDURE.

(1) Circuit breakers open or defective	Inspect for open circuit breaker.	Close circuit breakers if open.
	Deengergize electrical buses and perform continuity check of breaker.	Replace circuit breakers if defective.

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Possible Causes	Isolation Procedure	Correction

B. CABIN WILL NOT COOL SUFFICIENTLY BY EITHER THE MANUAL OR AUTOMATIC TEMPERATURE CONTROL SYSTEM (CONTINUED)

(2) Air conditioning control circuit	Connect ground electrical power. Move temperature control knob to manual WARM, then manual COOL and check that mix valve position indicator pointer moves toward HOT, then to full COLD.	If mix valve position indicator is not to full COLD--Check temperature control system per trouble shooting procedure. For temperature control trouble shooting,

			(see 21-60-0).
(3)	Left or right air conditioning pack	Pressurize pneumatic manifold to a minimum of 25 psig. Operate only one system at a time. Place pack switch to ON. Allow temperature to stabilize, then check pack temperature to isolate pack causing trouble. Reading of 43°F (6°C) or above indicates a faulty system.	If air conditioning pack is faulty, proceed to step (4). If air conditioning system is operational, proceed to step (8).
(4)	Ram air exhaust louver doors	Place cooling doors switch to OPEN. Check that ram air exhaust louver doors are full open.	If not full open -- Check ram air system per adjustment/test procedure (see 21-56-1).
(5)	Ram air ducting	Remove ram air duct inspection doors and inspect for obstructions inside ducts.	Remove obstructions inside ducts.
(6)	35°F control valve	Check 35°F control valve position indicator.	If 35° control valve is not full closed, perform 35° control system BITE test (see 21-55-7).

	Possible Causes	Isolation Procedure	Correction
B.	CABIN WILL NOT COOL SUFFICIENTLY BY EITHER THE MANUAL OR AUTOMATIC TEMPERATURE CONTROL SYSTEM (CONTINUED)		
(7)	Cooling system defective	Replace or repair faulty component.	Recheck duct temperature to verify that condition has been corrected.
(8)	Pneumatic system	Cooling system operational.	Check pneumatic system per trouble shooting procedure. See

ing procedure. See Chapter 36.

C. RAM AIR EXHAUST LOUVER DOORS WILL NOT OPERATE BY USE OF COOLING DOORS SWITCH.

WARNING: BEFORE DISCONNECTING ELECTRICAL CONNECTORS TO PERFORM ANY ISOLATION PROCEDURE, OPEN APPLICABLE CIRCUIT BREAKERS TO MAKE SURE ELECTRICAL CIRCUITS ARE DEENERGIZED. CLOSE CIRCUIT BREAKERS AFTER CONNECTORS ARE REMOVED, AS REQUIRED, TO PERFORM ISOLATION PROCEDURE.

(1)	Circuit breakers open or defective	Inspect for open circuit breaker.	Close circuit breakers if open.
		Deenergize electrical buses and perform continuity check of breaker.	Replace circuit breakers if defective.
(2)	No electrical power at ram air exhaust louver doors actuator	Remove electrical connector from ram air exhaust louver door actuator, then check for 115V AC at connector with pack cooling door switch in CLOSE position and with switch at OPEN.	If power is present at connector, replace ram air exhaust louver doors actuator. If power is not present at connector, replace pack cooling door switch.
(3)	Faulty airplane wiring	Perform continuity and resistance checks of airplane wiring (see Wiring Diagram Manual).	Replace or repair wiring as required.

CARGO COMPARTMENT TEMPERATURE SWITCH - MAINTENANCE PRACTICES

1. General

   A. The cargo compartment temperature switch is installed on the aft bulkhead of the forward cargo compartment.

   B. Access to the switch is through the forward cargo compartment.

   C. The temperature switch test checks the ability of the switches to operate the radio rack blower and animal compartment heat shut-off valve.

2. Tools and Equipment Required

2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
R A	Multimeter	2000A	DANA	Check continuity
B	Hilsch Tube	SS-8	Fisher Governor Co.	Change temperature
C	Thermometer		Commercial	Check Temperature

3. Removal/Installation Cargo Compartment Temperature Switch

CAUTION: DO NOT OPERATE RADIO RACK EQUIPMENT WHEN RADIO RACK BLOWER IS INOPERATIVE. OPERATION OF THIS EQUIPMENT WITH BLOWER INOPERATIVE SHORTENS ITS LIFE.

A. Remove Cargo Compartment Temperature Switch

(1) Open radio rack blower warning circuit breaker located on miscellaneous dc bus 1 section of EPC circuit breaker panel.

(2) Place blower switch in off position.

(3) Remove dome fixture from switch installation.

(4) Disconnect electrical wires.

(5) Remove switch.

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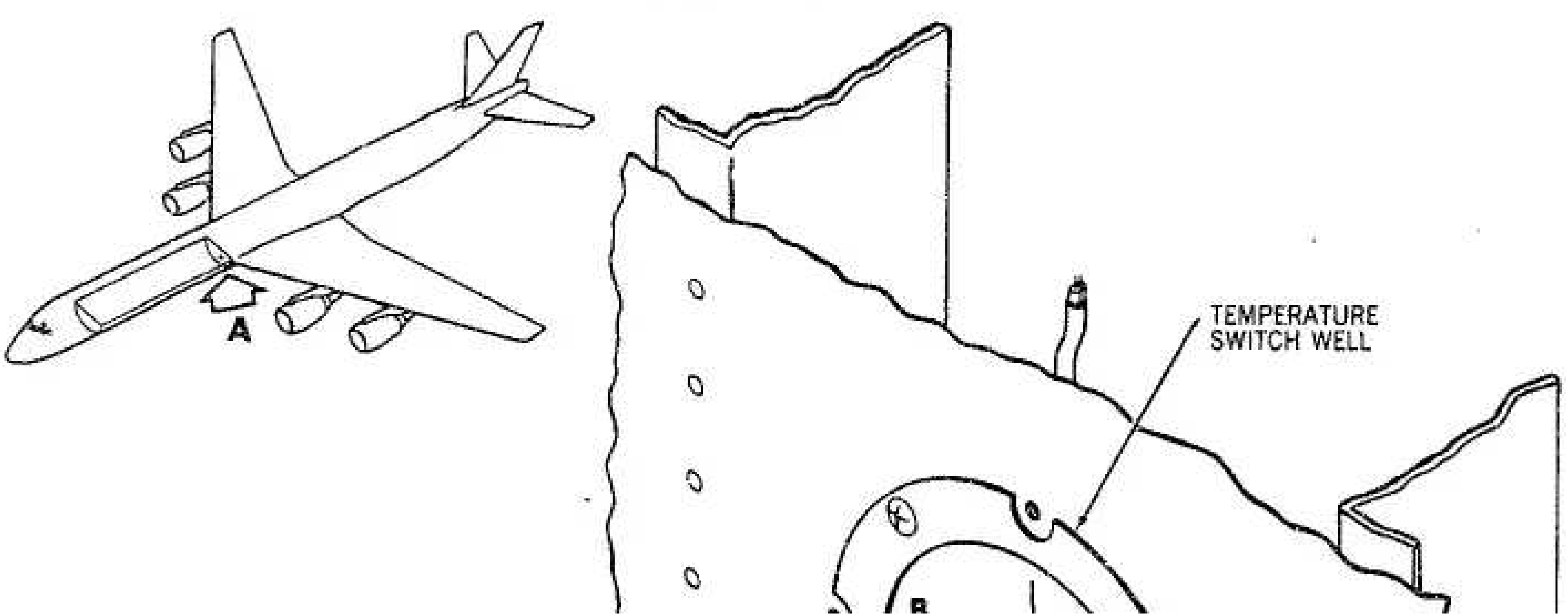

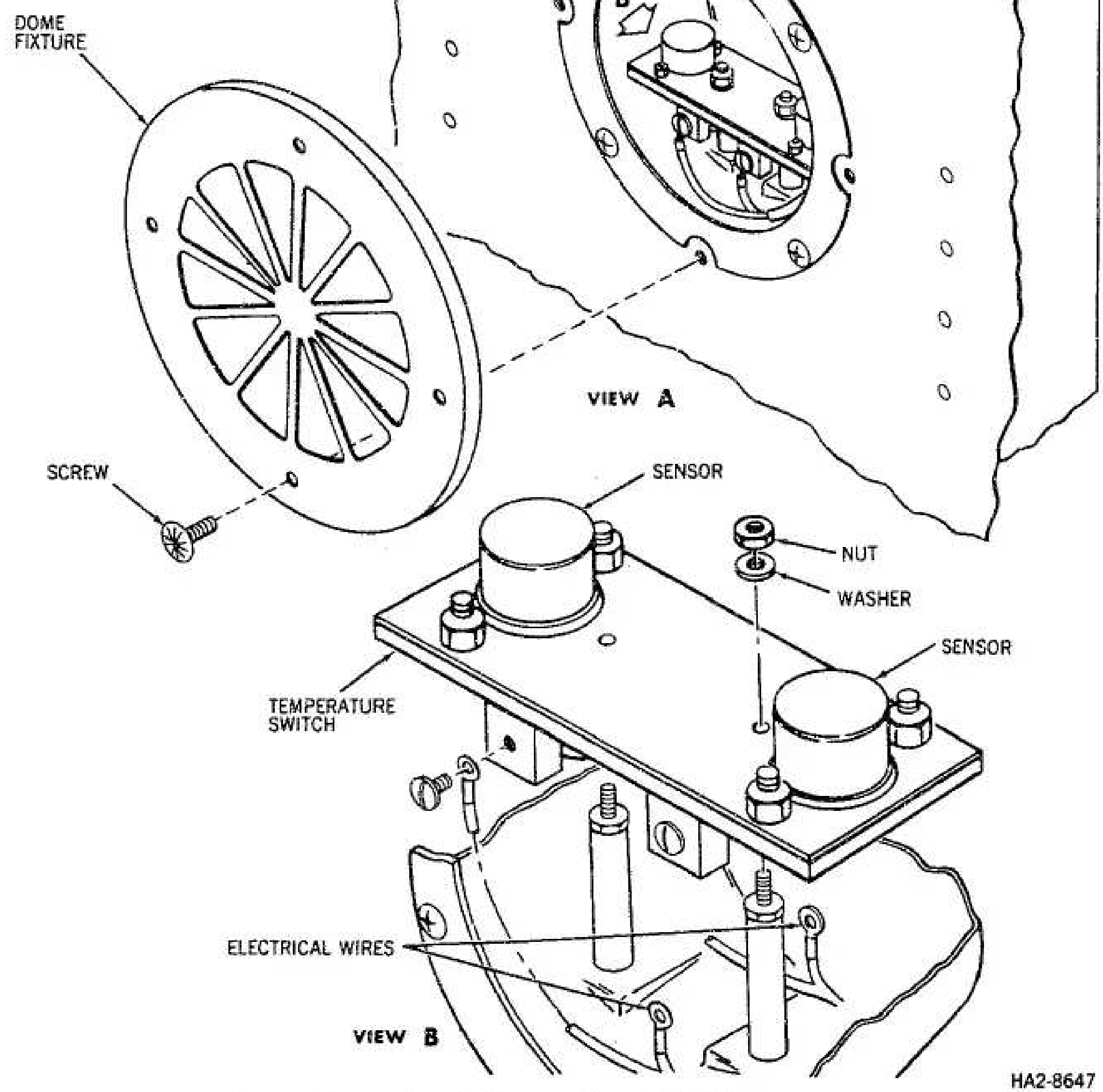

Cargo Compartment Temperature Switch -- Installation
Figure 201

B. Install Cargo Compartment Temperature Switch

(1) Make certain that radio rack blower warning circuit breaker, located on miscellaneous dc bus 1 section of EPC circuit breaker panel, is open.

(2) Install switch.

(3) Connect electrical wires.

(4) Install dome fixture.

(5) Close radio rack blower warning circuit breaker.

(6) Test temperature switch (see paragraphs 4 or 5).

4. Adjustment/Test Cargo Compartment Temperature Switch

A. Test Cargo Compartment Temperature Switch

(1) Remove dome fixture from switch installation.

(2) Disconnect electrical wires from cargo compartment temperature switch.

(3) Apply air from Hilsch Tube to cargo compartment temperature switch to lower temperature below 65°F (18.3°C).

(4) Check that continuity exists between terminals 1 and 2.

(5) Check that continuity exists between terminals 3 and 4.

(6) Raise temperature at switch to above 75°F (23.9°C).

(7) Check that no continuity exists between terminals 1 and 2.

(8) Check that no continuity exists between terminals 3 and 4.

(9) Connect electrical wires to switch.

(10) Install dome fixture.

5. Alternate Adjustment/Test Cargo Compartment Temperature Switch

A. Test Cargo Compartment Temperature Switch

(1) Disconnect animal compartment heat shutoff valve hose from fitting on radio rack discharge duct. Restrain loose end.

(2) Check that radio rack blower switch is in normal position.

NOTE: With the airplane on the ground (ground control relays energized) the radio rack blower should operate continuously regardless of blower switch position or temperature in cargo compartment.

(3) Pressurize pneumatic manifold (see Chapter 36).

(4) Open left ground control relay circuit breaker located on miscellaneous ac bus section of EPC circuit breaker panel.

WARNING: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL RELAY CIRCUIT BREAKER IS OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(5) Using Hilsch Tube, flow air across cargo compartment temperature switch to maintain temperature just above 75°F (23.9°C). Check following:

(a) Radio rack blower is not operating.

(b) Animal compartment heat shutoff valve is closed (no air flow from disconnected hose).

NOTE: Air conditioning system may be started (see 21-00, Description and Operation) to obtain desired temperatures at compartment temperature switch.

(6) Flow air across cargo compartment temperature switch to decrease temperature to approximately 55°F (12.8°C). Check following:

(a) Radio rack blower is operating.

(b) Animal compartment heat shutoff valve is open (air flows from disconnected hose).

(7) Depressurize pneumatic manifold (see Chapter 36).

(8) Close ground control relay circuit breaker.

(9) Connect animal compartment heat shutoff valve hose to fitting on radio rack discharge duct.

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COOLING PACKS - DESCRIPTION AND OPERATION

1. General

A. Air conditioning cooling is provided by two cooling packs. The packs also remove excess moisture from the air.

B. Cooling pack equipment is located on either side of the airplane centerline in the areas at the sides of the nose wheel area. (see Figure 1).

C. The cooling devices used in the cooling packs consist of a primary heat exchanger, a secondary heat exchanger, and an air cycle machine. The heat exchangers are of the air-to-air type with heat being transferred from the air going through the packs to air going through a ram air system. The air

cycle machine consists of a turbine and a compressor. Air passing through the secondary heat exchanger and expanding through the turbine drops in temperature as the energy is extracted. The expanding air releases energy to drive the compressor. The compressed air increases the temperature to the secondary heat exchanger, thus improving the heat transfer efficiency of the secondary heat exchanger.

D. Protection of the air cycle machine is provided by two thermal switches. One thermal switch senses compressor discharge temperature. The other thermal switch senses turbine inlet temperature. Actuation of either thermal switch will cause the pack valve to close.

E. As the air cools its moisture content condenses. The moisture is atomized so finely however, that it will stay in suspension without a moisture removing device. The water separator collects this atomized moisture and removes it from the cooling pack air after it has left the air cycle machine.

F. Moisture entering the water separator is kept from freezing by a 35°F control system. A 35°F sensor in the water separator and a 35°F control regulate a control valve in a duct between the primary heat exchanger exit and the water separator inlet. The valve opens to add warm air if the turbine discharge temperature approaches the freezing temperature of water.

2. Component Description

A. Primary Heat Exchanger

(1) The primary heat exchanger is the first unit of the cooling packs through which engine bleed air passes to be cooled. The unit is rectangular in shape and is located between two sections of the ram air duct. The heat exchangers are of the true counterflow plate-fin type.

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(2) Hot air enters one plenum chamber from the pneumatic duct at the aft upper end of the exchanger. It is cooled as it passes between the sandwiched plates and fins to the other plenum chamber, then leaves by way of the air cycle machine duct connected to the forward lower side of the heat exchanger or when cooling requirements are such that the mix valve has closed off airflow through the air cycle machine considerably that air will pass directly forward through the air cycle machine control check valve, located between the primary and secondary heat exchanger, to the secondary heat exchanger. There is one primary heat exchanger for each cooling pack.

B. Air Cycle Machine

(1) The air cycle machine is a cooling unit consisting of an expansion turbine on a common shaft with a compressor. The shaft is bearing mounted

in a housing to support the rotating turbine and compressor. A wick extends from the shaft to the bottom of the oil sump formed by the housing for lubrication of the moving parts. A filler plug and sight gege are provided on each side of the housing, with a magnetic oil drain plug on the bottom.

(2) The air cycle machine is located inboard of the secondary heat exchanger (see Figure 1). A duct from the compressor and another to the turbine connect to the secondary heat exchanger. The turbine mounts are connected to a mounting pan through serrated plates and washers to provide location adjustment. There is one air cycle machine for each cooling pack.

C. Secondary Heat Exchanger

(1) The secondary heat exchanger is identical to the primary heat exchanger in construction. However the operation is different and is discussed in the following paragraphs. The secondary heat exchanger is located forward of the primary heat exchanger. There is one secondary heat exchanger for each cooling pack.

(2) With the mix valve hot valve full closed and intermediate valve (bypass) full closed air from the air cycle machine compressor outlet enters the aft lower connections of the secondary heat exchanger, passes between the sandwiched plates and fins, then returns to the air cycle machine turbine inlet from the forward lower exchanger connection.

(3) With the mix valve cold valve full closed and intermediate valve full open air will bypass the air cycle machine and flow through secondary heat exchanger between the sandwiched plates and fins directly to the open intermediate valve port of the mix valve.

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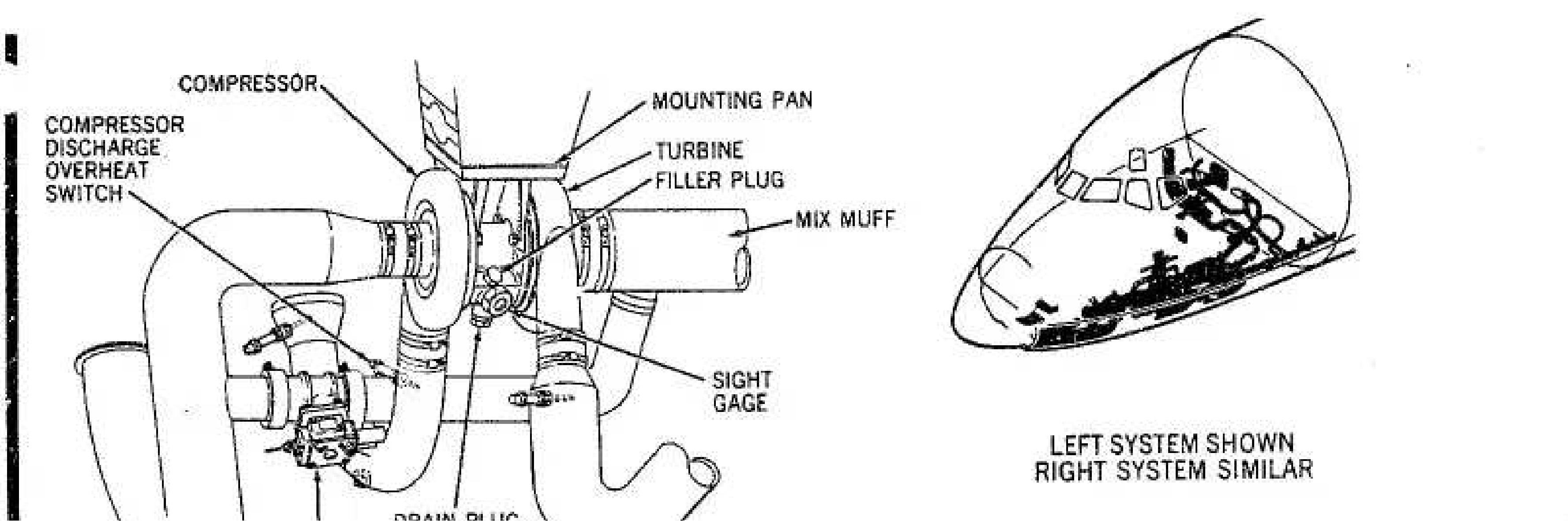

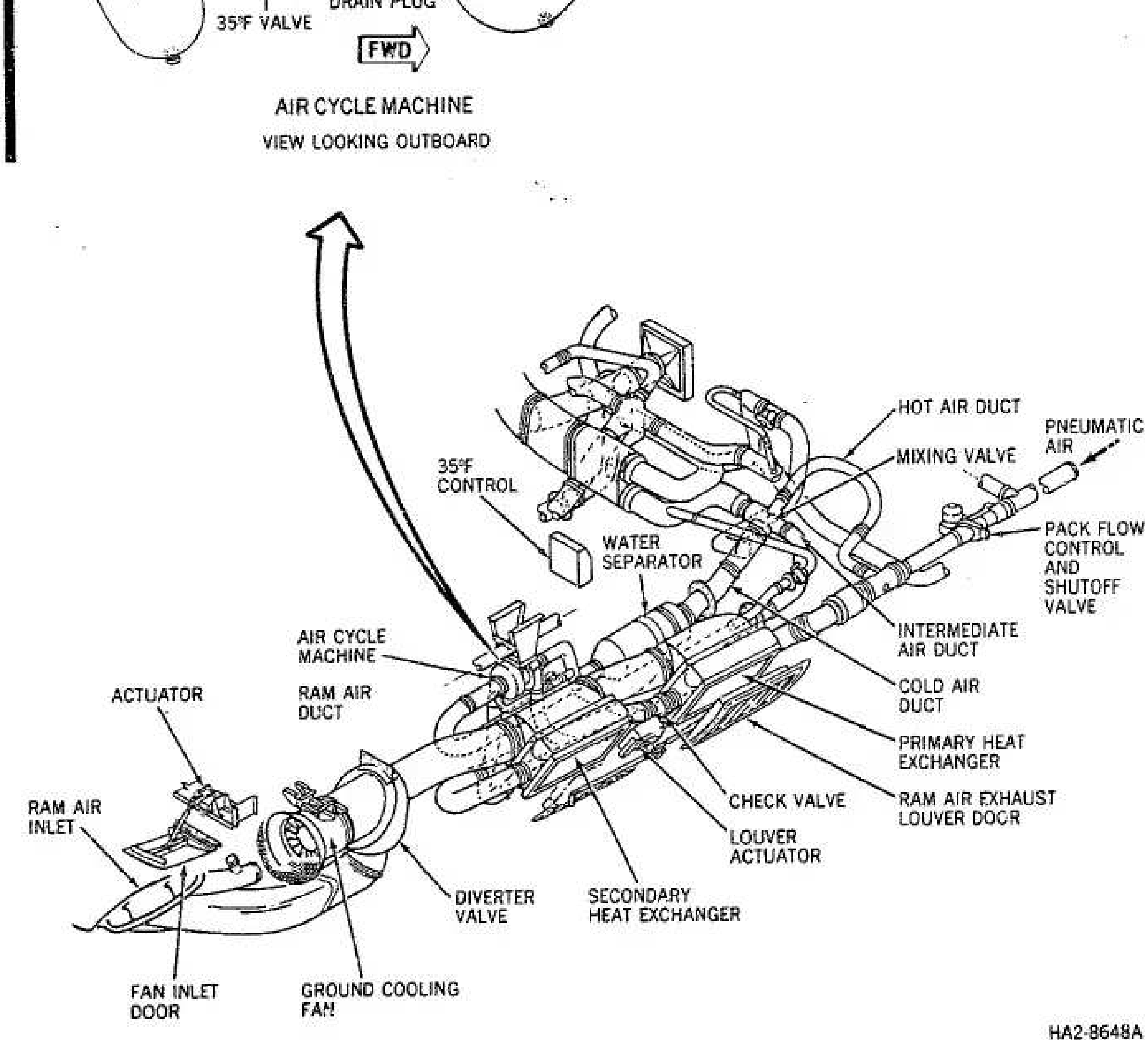

Cooling Pack Component Location
Figure 1

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(4) Between the cold position and bypass position air can enter from either the air cycle machine or primary heat exchanger or a combination of both depending on position of the mix valve. Air will continue to be cooled through the secondary heat exchanger until the mix valve moves to full hot.

C. Thermal Sensing Units

(1) Two thermal switches are in the cooling system, and directly affect the cooling pack operation. One thermal switch senses compressor discharge temperature. The other thermal switch senses turbine inlet temperature When an overheat condition exists in either position the affected thermal switch will cause the pack valve to close. Other thermal sensing switches located in air conditioning are covered under temperature control system.

(2) The turbine inlet overheat switch is located in the transition at the secondary heat exchanger and senses the temperature of air passing from the heat exchanger to the turbine of the air cycle machine.

(3) The compressor discharge overheat switch senses temperature of air being discharged from the compressor to the secondary heat exchanger.

D. Check Valves

(1) Three check valves are provided for each air conditioning pack. One valve is located in the cold air duct between the water separator and mix valve. A second valve, the air cycle machine contrc' check valve is located between the primary and secondary heat exchangers. The third valve is located in the intermediate air duct between the secondary heat exchanger and mix valve.

(2) The cold air and intermediate air check valves located forward of the mix valve prevent loss of air from the distribution system should a failure occur in the cooling pack area.

(3) The air cycle machine control check valve prevents reverse flow of air from the secondary heat exchanger through the air cycle machine compressor back into the primary heat exchanger.

E. Water Separator

(1) Cold air leaving the air cycle machine is ducted to the water separator (see Figure 2). Moisture in the air at this reduced temperature begins to condense. The condensate is so finely atomized however, that it will follow along in the air stream unless a suitable method is used to collect it. The water separator is used to collect and remove the excess moisture from the air before it enters the distribution system.

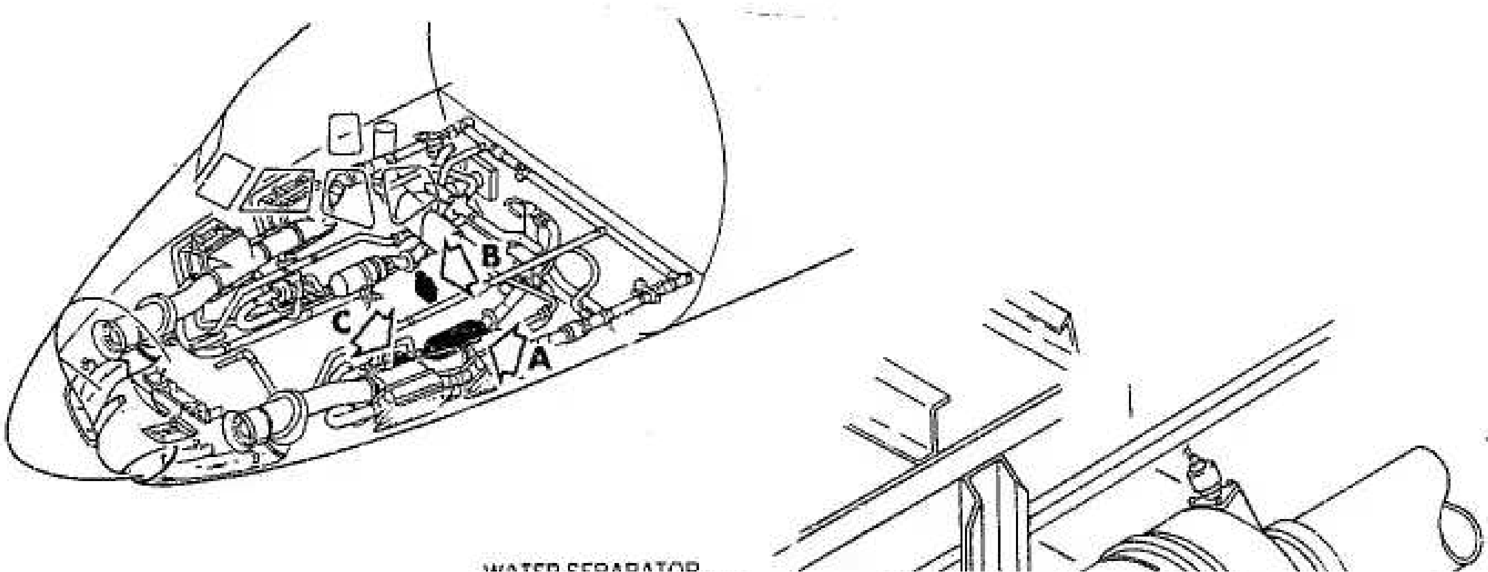
(2) The water separator is a cylindrical chamber consisting of an inlet and outlet shell assembly which houses a polyester coalescer (bag), a conical-shaped metal coalescer support, a bypass valve assembly, and a valve support guide. A coupling joins the inlet and outlet shell assemblies and secures the coalescer support. The outlet shell assembly contains a collection chamber, a baffle, and an overboard water drain. A boss is also provided for the installation of a temperature sensing probe.

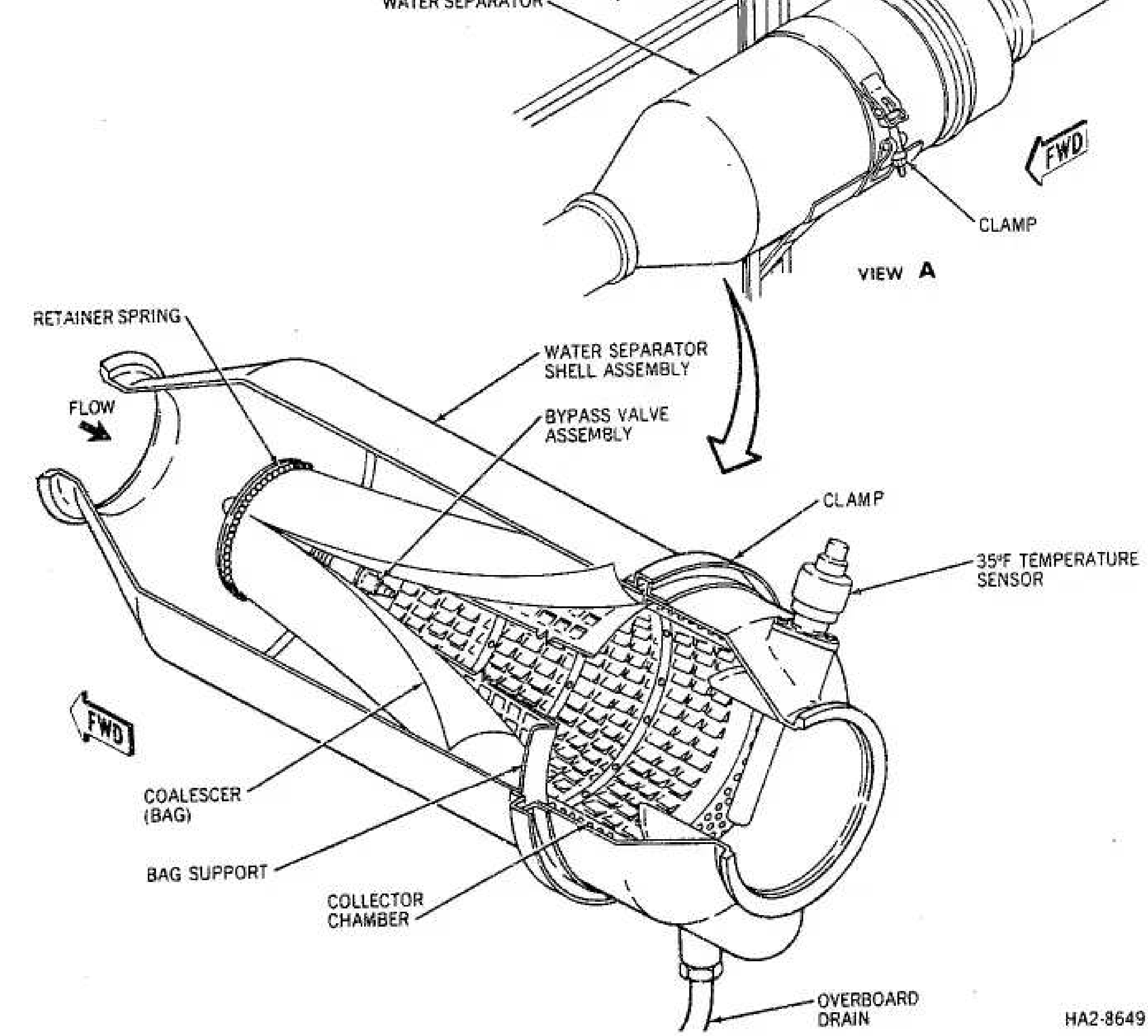
(3) The coalescer bag and its support are conically shaped with the small diameter at the upstream end. The support fits inside the bag and has louvers shaped to impart a whirling motion of air as it passes through. Air enters the separator around the outside of the bag, passes through the bag, then through the louvers. As the damp air passes through the bag, the bag is wetted and larger droplets of water are formed. These

droplets along with the air are caused to whirl by the louvers of the support. As the air and moisture pass through the separator the centrifugal force keeps the heavier moisture close to the inside of the support until it reaches the collection chamber. A cylindrical baffle approximately the diameter of the outlet duct extends inside the separator at the downstream end. The water and air whirling in a greater diameter than the baffle find it necessary to make a double reverse turn in order to leave the separator. The turning does not appreciably affect airflow but the water being much heavier cannot make the turn and remains in the collection chamber. A port in the bottom of the collection chamber allows moisture to drain overboard (see Figure 2).

(4) The bypass valve allows air to pass through the water separator to the distribution system without first passing through the coalescer bag. The valve opens as a result of increased pressure differential should the coalescer bag become clogged or frozen. At a low altitude, it is desirable to remove moisture from the air, but at approximately 20,000 feet the air moisture content is negligible. The bypass valve opens at lower altitudes only when the coalescer bag becomes excessively clogged to allow passage of sufficient air for proper ventilation and cabin pressure. The bypass valve assembly is secured to a mounting ring within the inlet shell assembly and consists of a spring-loaded poppet and piston, seat, and poppet arrangement.

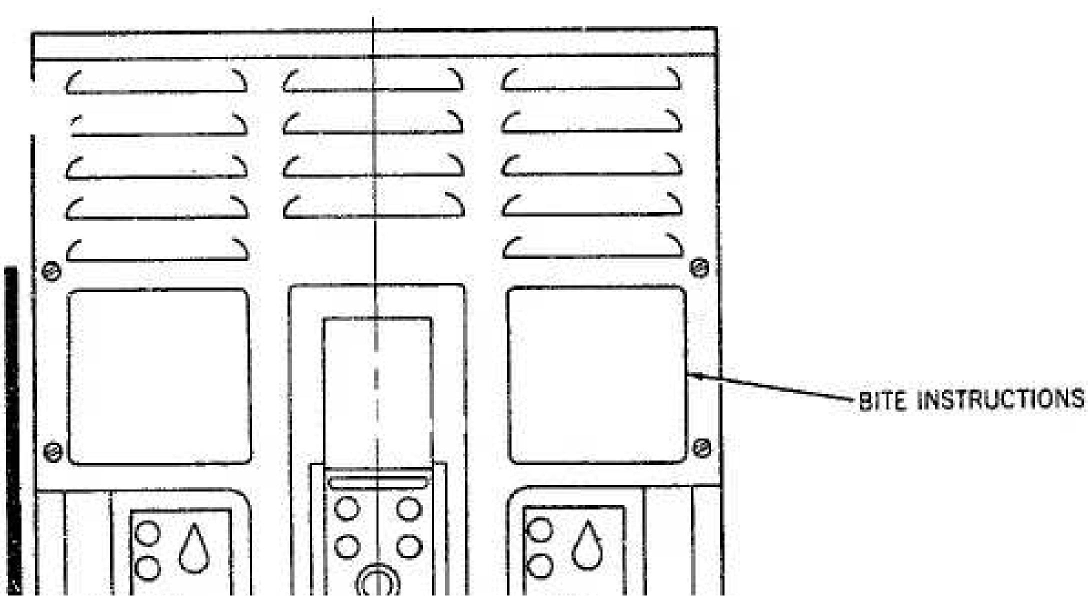
(5) If the coalescer bag is clogged, airflow through the water separator is retarded and causes an increase in pressure across the bypass valve. When the pressure differential exceeds the force of the valve loading spring, the valve opens and a portion of the air passes through the valve without first passing through the bag.

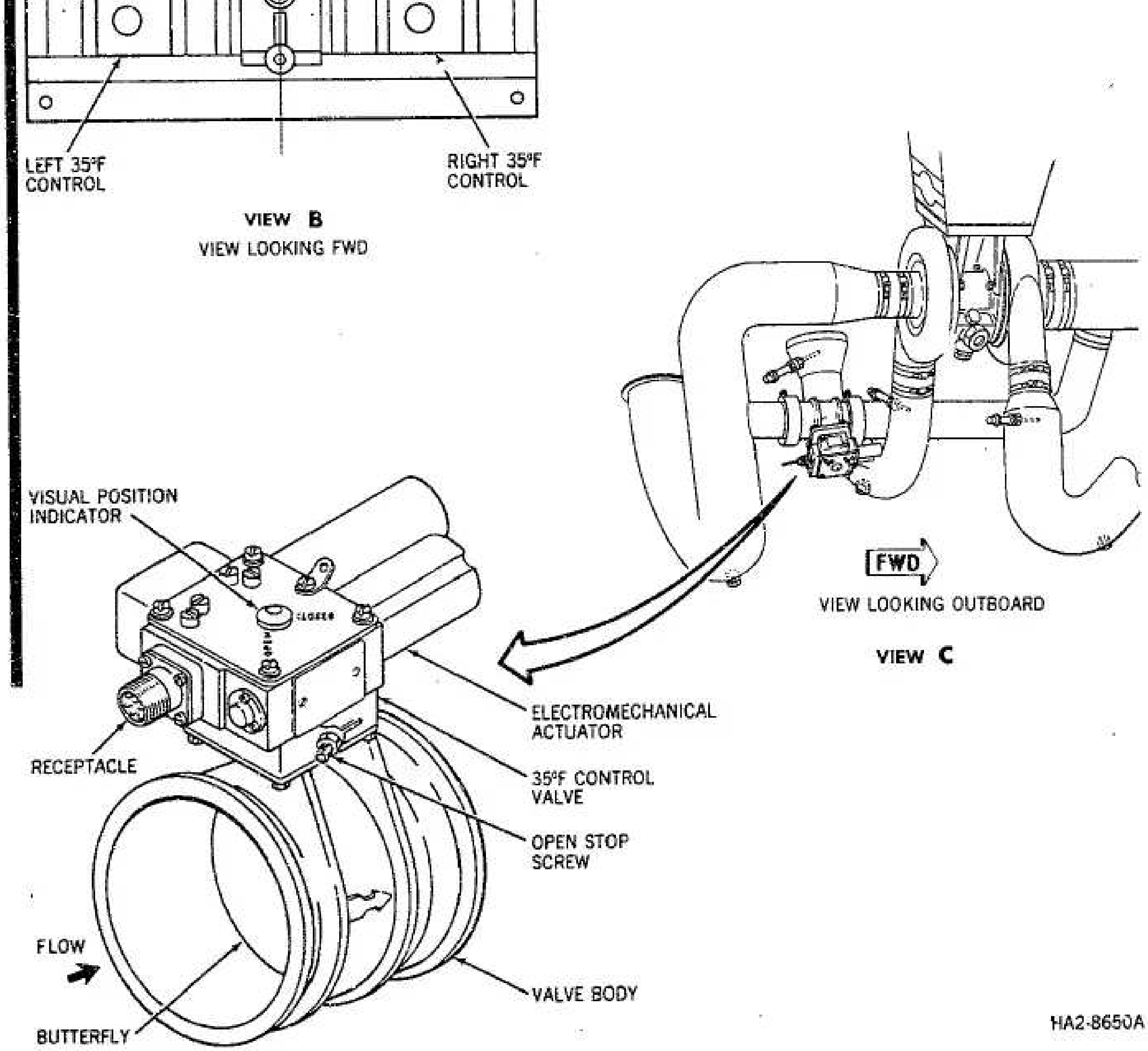




Water Separator 35°F Control System Component Location
Figure 2 (Sheet 1)

TOC





Water Separator 35°F Control System Component Location
Figure 2 (Sheet 2)

F. Water Separator 35°F Control System

(1) When cooling requirements are high, the temperature of the air as it leaves the air cycle machine may drop below the freezing point of water. The water separator 35°F control system regulates air temperature into the separator to keep moisture from freezing in the turbine exit and on the water separator coalescer bag.

(2) Keeping water separator temperature above freezing is accomplished by taking hot air from upstream of the air cycle machine compressor and routing it back into the system at the air cycle machine turbine discharge mix muff. The water separator 35°F control system regulates the quantity of air being bypassed.

(3) The water separator 35°F control system consists of a water separator 35°F sensor, control, and valve. The sensor is located in the outlet

end of the water separator, the control is located in the air conditioning accessory compartment, and the valve is located inboard of the air cycle machine in the duct that connects between the compressor side of the air cycle machine and the inlet duct of the turbine outlet mixing duct (see Figure 2).

(4) The 35°F sensor is one element of the 35°F control. The control contains a bridge circuit, an amplifier, and a silicon-controlled rectifier actuator control. The sensor is utilized as a remotely located variable resistance for one leg of the bridge circuit. As temperature at the sensor changes, its resistance changes, unbalancing the bridge. The bridge circuit is connected to the amplifier. The amplifier interprets the signal received and then signals the actuator control to move the valve open or closed. When the bridge is balanced current is shut off to the valve and it maintains the position held. The bridge balances with temperature in the separator at approximately 35°F (see Figure 3).

(5) The 35°F control contains built-in test circuits which provide a quick check of the 35°F control system, a test switch, two indicator lights and a test instrument placard. The test switch is a rotary type with five test positions and one flight position. The switch is spring loaded and will return to the flight position upon release.

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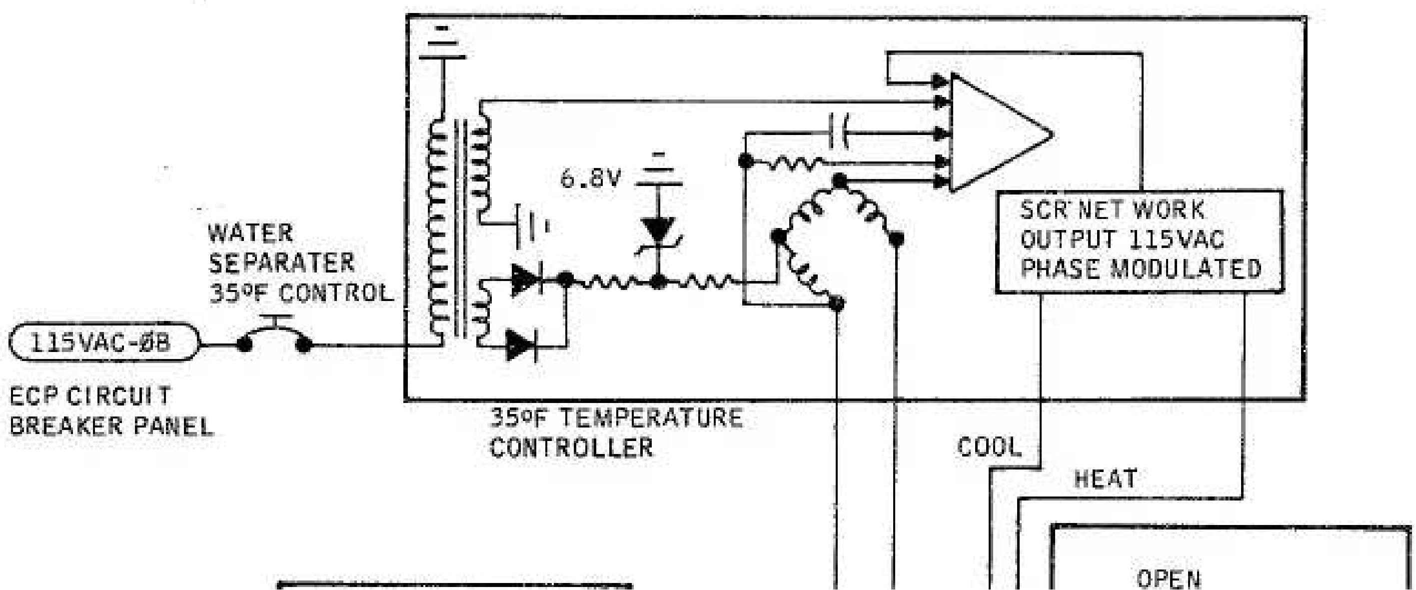

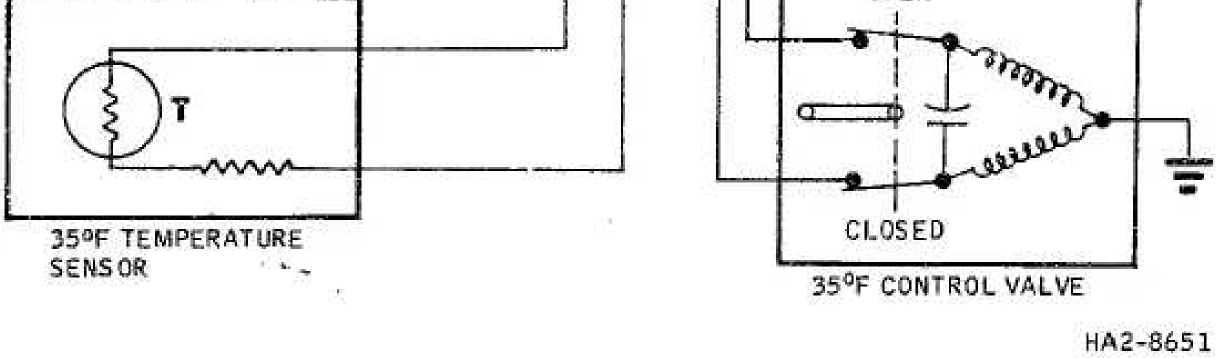

Water Separator 35°F Control System Circuit
Figure 3

3. Operation

A. When air conditioning is turned on, the pack flow control and shutoff valve opens and hot air from the pneumatic system enters the air conditioning system. Depending on cabin temperature requirements, the mix valves adjust to send the required portion of this air through the cooling packs. The remainder passes unchanged through a duct to the mix valves (see Figure 4).

B. The air entering the packs first passes through the primary heat exchanger where some heat is removed by incoming ram air. This air still at a high temperature, flows on to the air cycle machine (ACM) where it passes through the ACM compressor and secondary heat exchanger before it reaches the ACM turbine. The turbine then drives the compressor. As the air is compressed, its temperature and pressure rise. The secondary heat exchanger then lowers the temperature to approximately the value it was as it entered the compressor but at a higher pressure. The air expands as it drives the turbine and leaves the turbine at the coolest temperature of the cycle.

C. Should the temperature of the air leaving the compressor reach 390 ± 10°F (199 ± 6°C), the compressor discharge overheat switch will close to energize the pack trip relay. Energizing the relay completes circuits to close the pack valve, illuminate the pack trip-light, and to hold the pack valve closed until the air has cooled. Pushing the pack trip reset switch will return the system to normal operation after the overheat condition has been corrected.

D. Unless the secondary heat exchanger reduces the temperature of the air sufficiently, overspeed of the turbine may occur. At a turbine inlet temperature of 210 ± 10°F (100 ± 5°C), the turbine inlet overheat switch will close. Closing of this switch will also energize the pack trip relay to close the pack valve, illuminate the trip light, and hold the valve closed until the overheat condition has been corrected and the pack trip switch is reset.

E. From the air cycle machine turbine the air is ducted to the water separator. Excess moisture condenses from the air at the reduced temperature and is separated from the air and drained overboard. The water separator 35°F control system bypasses primary heat exchanger air around the air cycle machine, if needed, to prevent water freezing in the separator.

F. Cold air leaving the water separator then travels to the air mix valve. If less than maximum cooling capacity is required from the system, the mix valve is modulated to allow part of the air to bypass the air cycle machine through the intermediate port of the mix valve.

G. The ports of the mix valve are mechanically linked in such a way that starting from the full cold position for approximately 40% of the actuator travel the intermediate port opens linearly as the cold port remains fully open and the hot port remains fully closed. For the next 60% of travel the hot port opens linearly as the cold port and intermediate port close linearly (see Figure 5).

H. If full heat is required, all the air will bypass the heat exchangers and air cycle machine through the full open (hot) port of the mix valve with the cold and intermediate ports in the full closed position.

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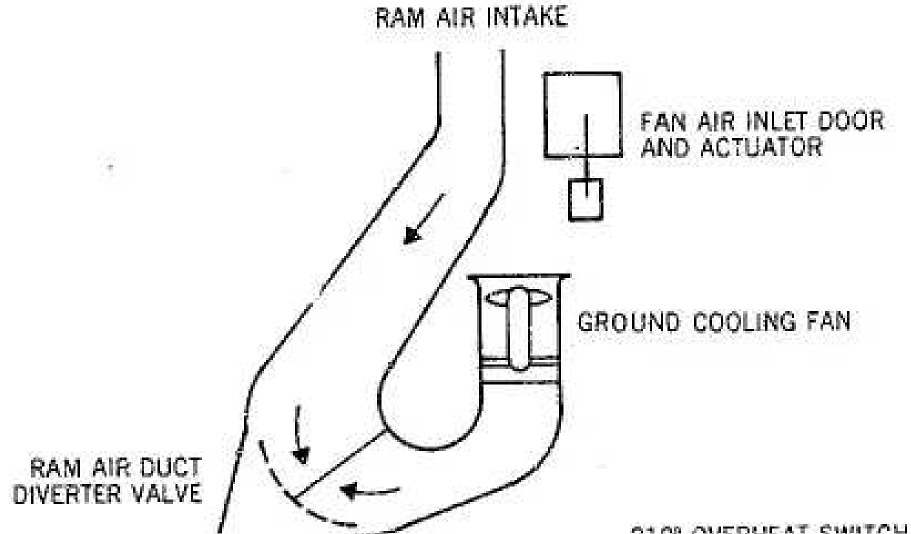

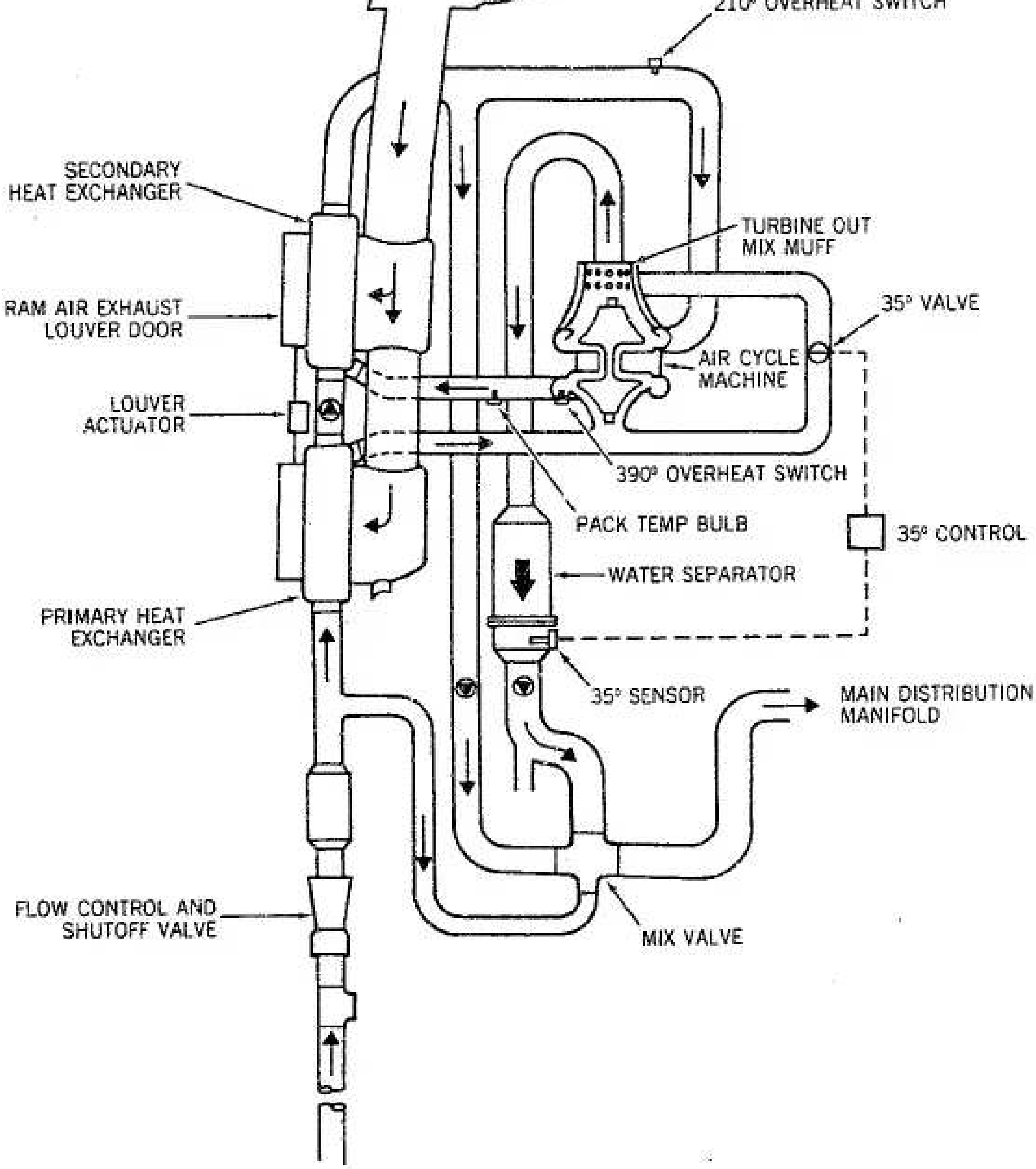

Cooling Pack Airflow Diagram
Figure 4

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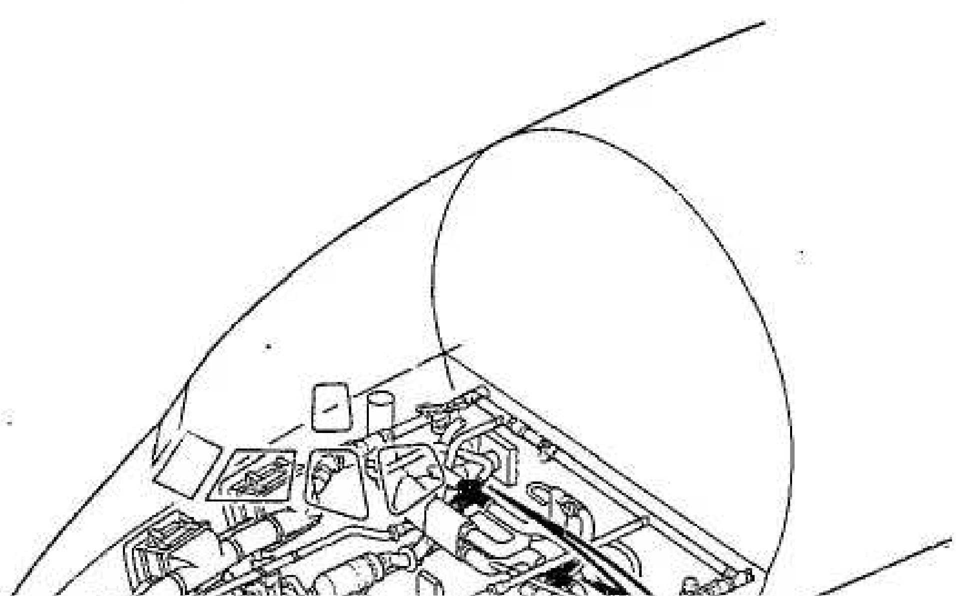

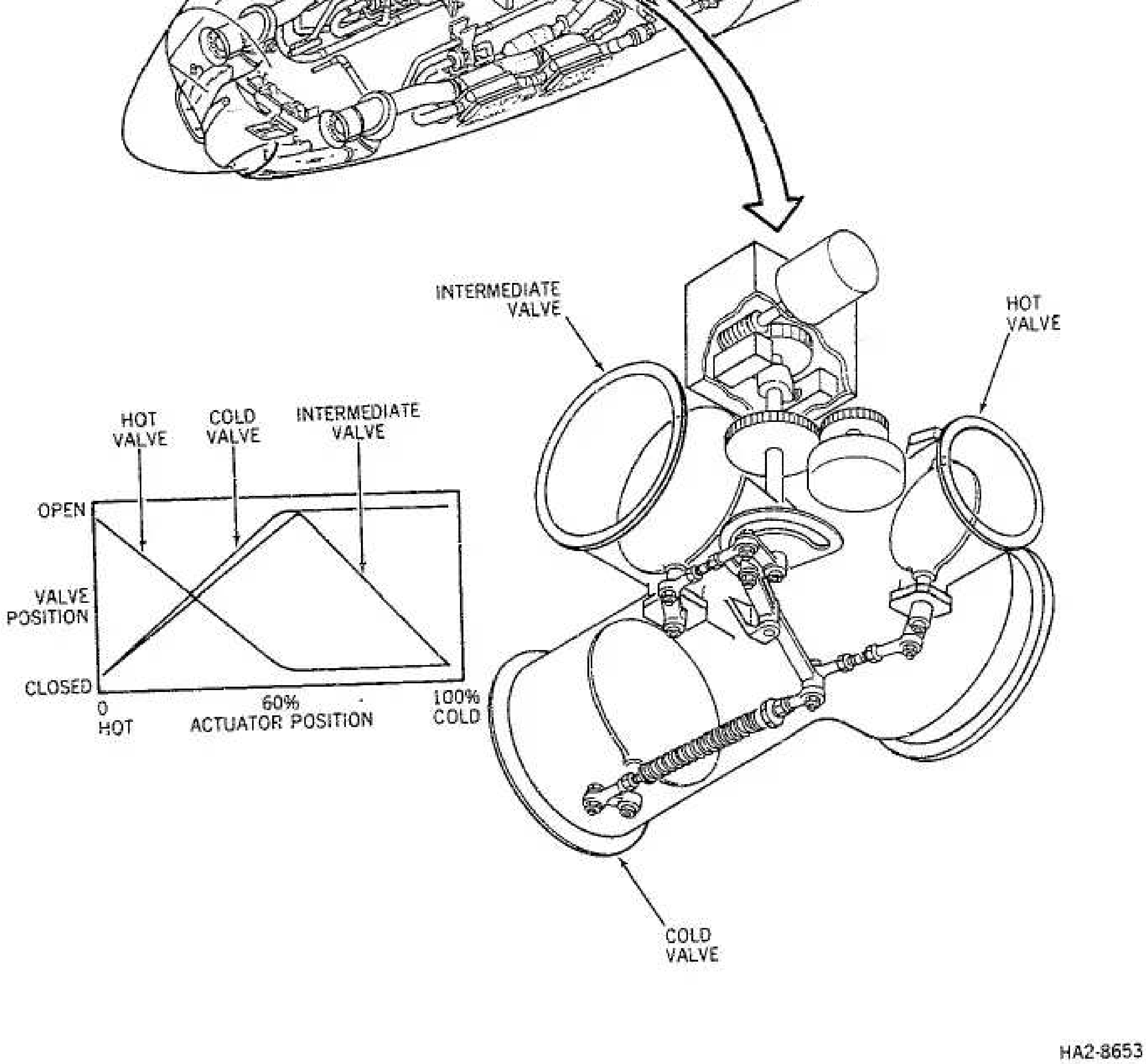

Mix Valve
Figure 5

COOLING PACKS - ADJUSTMENT/TEST

1. General

   A. This procedure provides an electrical check of cooling packs components and requires only that electrical power be provided to airplane. Checking air cycle machine, heat exchangers, and water separator anti-icing system requires that pneumatic system be pressurized. Both tests must be accomplished for complete system checkout.

2. Equipment and Materials

   A. Controlled Heat Source - Temp Cal probe heater (Attachment to Jet Cal

engine analyzer), or equivalent

B. Thermometer, Standard

3. Test Cooling Packs

A. Connect external electrical power and check that all air conditioning system circuit breakers are closed (see 21-00).

B. Open left and right pack cooling fan control circuit breakers, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

C. Check air cycle machine turbine inlet and compressor discharge overheat switches.

(1) Check that pack trip warning light comes on when pushed and goes off when released.

(2) Remove compressor discharge overheat switch (see Figure 501).

(3) Apply heat to thermal switch probe until it closes. Switch will close at approximately 390 $\pm$10°F. Check that pack trip light comes on.

(4) Push pack overheat reset switch and check that trip light goes off.

(5) Install compressor discharge overheat switch.

(6) Remove turbine inlet overheat switch from ACM turbine inlet duct.

(7) Apply heat to thermal switch probe until it closes. Switch will close at approximately 210 $\pm$10°F. Check that pack trip light comes on.

(8) Allow probe to cool until it can be held without discomfort then push the reset button. Check that trip light goes off.

(9) Install turbine inlet overheat switch.

(10) Move pack switch to OFF.

(11) Close left and right pack cooling fan control circuit breakers, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

D. Test compressor temperature indicating system.

(1) Remove compressor temperature bulb from ACM compressor discharge duct.

(2) Check that temperature as observed on compressor temperature indicator is approximately same as that observed on standard thermometer at temperature bulb.

(3) Apply heat to bulb and check that temperature reading on indicator rises. Apply heat only long enough to register a definite temperature increase on indicator.

<u>CAUTION</u>: SHOULD HEAT APPLIED EXCEED LIMITS OF INDICATOR, INDICATOR MAY BE DAMAGED.

(4) Install temperature bulb.

(5) Remove electrical power if no longer required.

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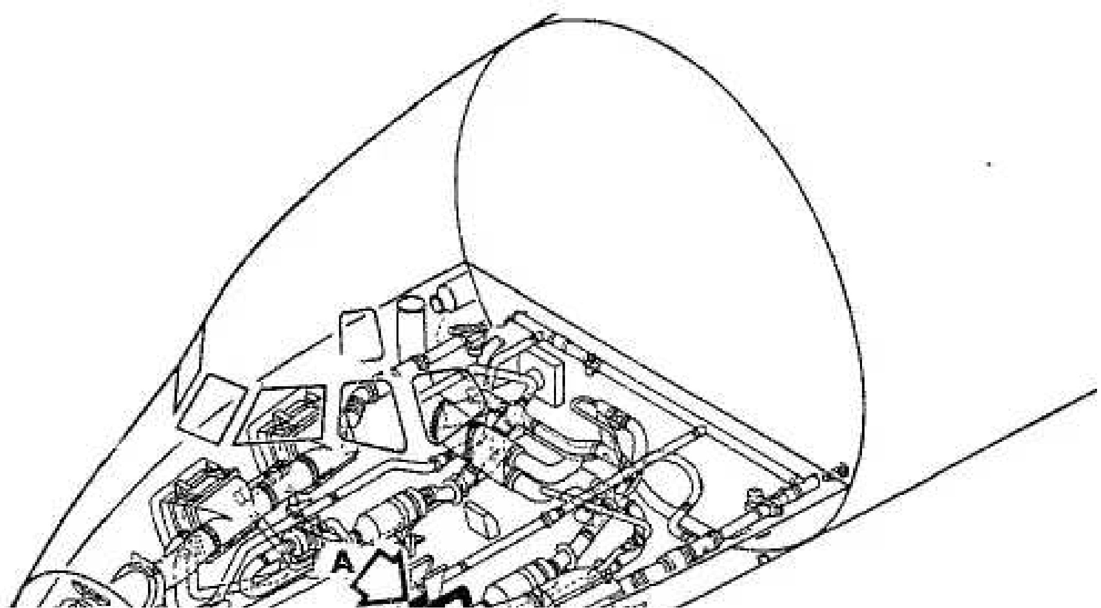

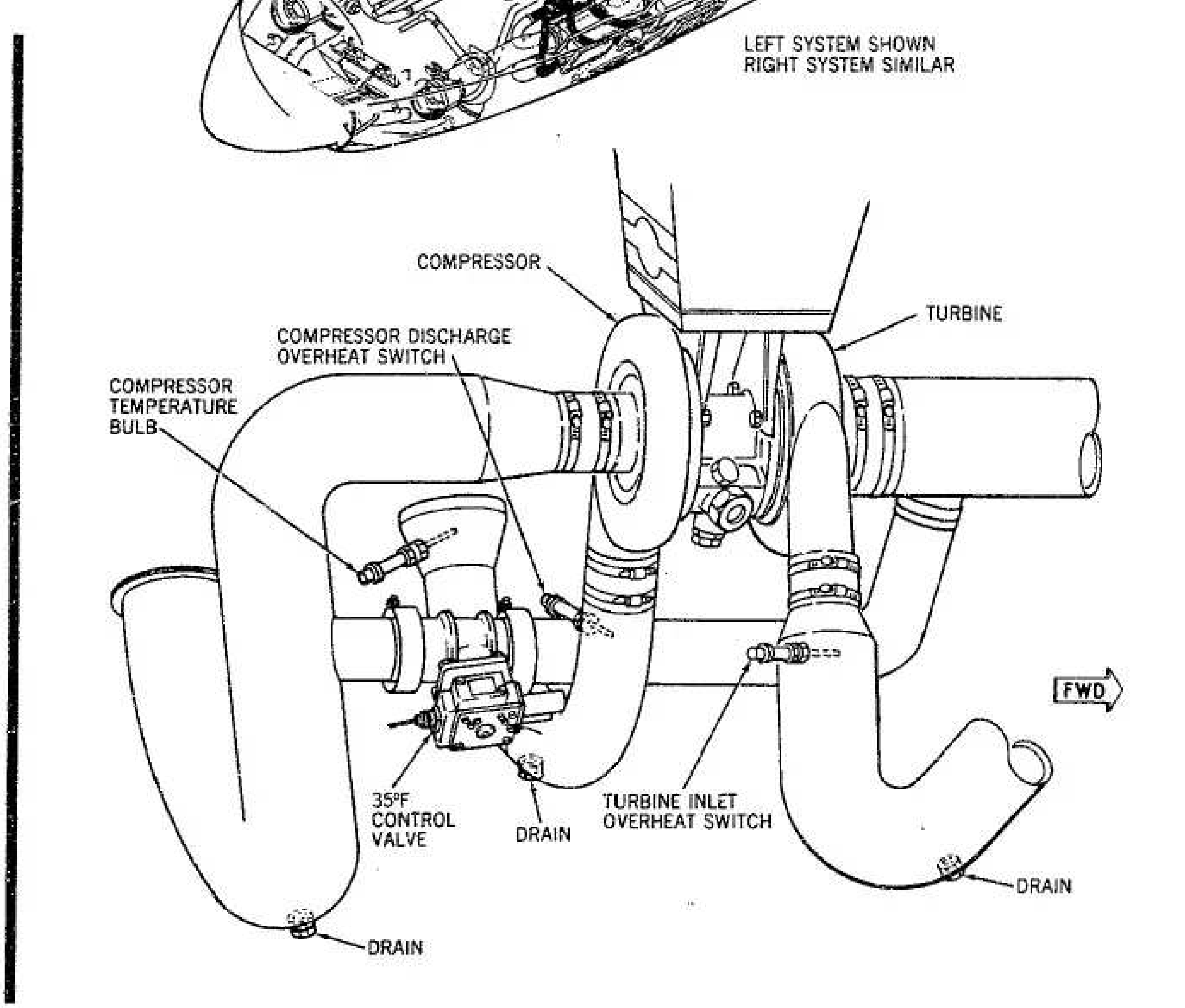

Thermal Sensing Units
Figure 501

AIR CYCLE MACHINE UNIT - SERVICING

1. General

A. The following procedure drains and refills the air cycle machine oil sump.

2. Tools and Equipment Required

A. Oil - Lubricating (Air Cycle Machine)

3. Drain Air Cycle Machine

3. Drain Air Cycle Machine

A. Access to air cycle machine is through nosewheel well area.

B. Remove filler plug from top of sump.

C. Remove drain plug from bottom of sump and drain oil.

4. Refill Air Cycle Machine

A. Install drain plug.

R B. Refill turbine sump until oil appears near top of gage (See 12-02).

C. Install filler plug.

TOC

AIR CYCLE MACHINE (ACM) - REMOVAL/INSTALLATION

1. General

A. One air cycle machine (ACM) is provided for each cooling pack. Since left and right ACM installations are alike, the following procedure will apply to either.

B. Access to air cycle machine is through nosewheel well side walls.

2. Prepare ACM for Removal

A. Drain oil from ACM.

3. Removal/Installation ACM (see Figure 401)

A. Remove ACM

(1) Open applicable circuit breakers located on EPC circuit breaker panel:

Circuit Breaker	Panel Section
Duct overheat	Heat, vent, and ice protection (dc bus)
Water separator 35°F Control	Heat, vent, and ice protection (dc bus)
R Pack trip	Battery direct bus (dc bus)
Pack compressor temperature indicator	Heat, vent, and ice protection (dc bus)

(2) Remove compressor and turbine inlet and outlet flexible connectors.

(3) Support ACM and pan and remove four mounting bolts.

(4) Remove ACM.

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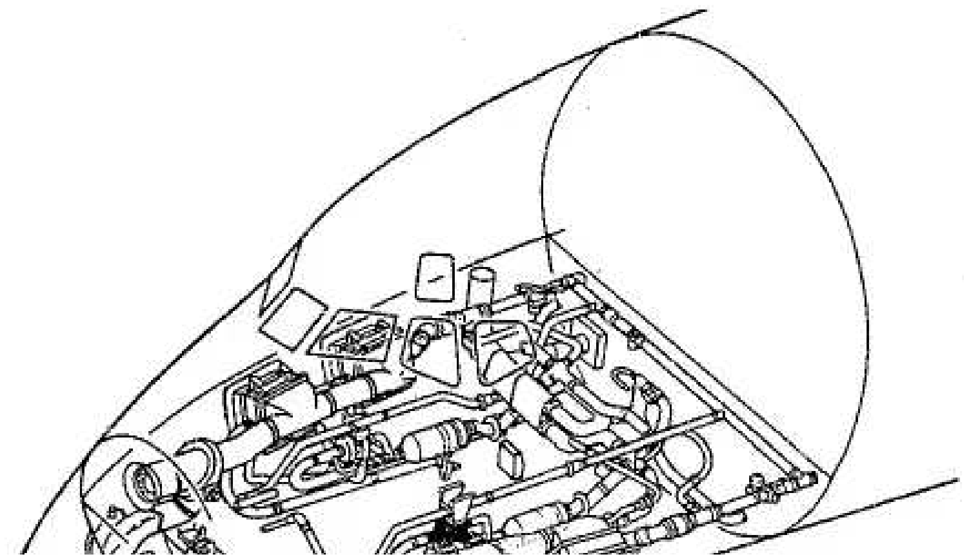
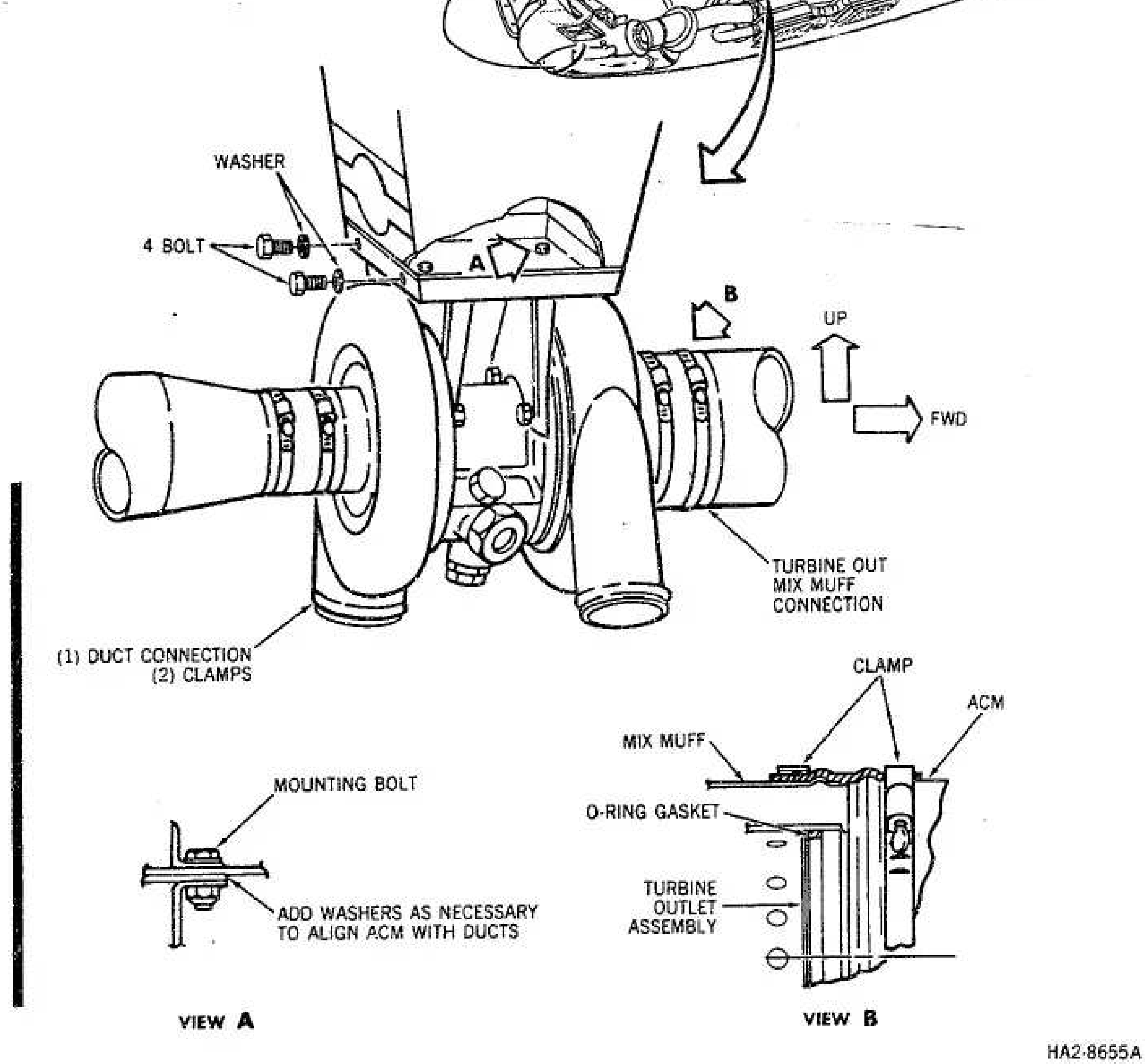




Air Cycle Machine Installation
Figure 401

B. Install ACM

(1) Install gasket on turbine out mix muff and check that flexible connectors are in place on ACM connecting ducts.

(2) Install pan on ACM with three mounting bolts.

(3) Lift ACM into place and secure pan with four mounting bolts.

(4) Move compressor inlet and turbine outlet ducts into place.

(5) Move compressor outlet and turbine inlet ducts into place.

(6) Check ACM for alignment with ducts. If alignment is necessary tilt ACM

by adding or removing one or more washers between pan assembly and ACM as shown in figure 401.

(7) Install flexible connector assembly at turbine and compressor inlets and outlets.

(8) Check condition of compressor discharge overheat switch connector with respect to loose pins or bad contacts and install on overheat switch.

CAUTION: MAKE SURE THAT CONNECTOR IS NOT DAMAGED DURING INSTALLATION. THIS CIRCUIT PROVIDES OVERHEAT PROTECTION AND IS NOT CHECKED DURING INSTALLATION TEST.

(9) Service ACM (see Air Cycle Machine - Servicing).

(10) Provide electrical power.

(11) Check that all air conditioning and pneumatic systems circuit breakers are closed (see 21-00).

(12) Pressurize pneumatic system (see Chapter 36).

(13) Open entry door or flight compartment window.

(14) Move applicable pack switch to on.

(15) Hold applicable cabin temperature selector toward manual cool until mix valve position indicator pointer moves to cold then return selector to OFF.

(16) Check for leakage at compressor inlet and outlet couplings and at turbine inlet and outlet couplings. Diffused leakage allowed, jet blasts are not.

WARNING: DO NOT ATTEMPT TO REPAIR JET BLAST LEAKAGE WITH PACKS ON OR PERSONNEL MAY BE INJURED.

(17) Move pack switch to off.

(18) Remove pneumatic pressure if no longer required.

(19) Remove electrical power if no longer required.

TOC

HEAT EXCHANGERS - REMOVAL/INSTALLATION

1. General

   A. Four heat exchangers are used in the air conditioning packs; one primary and one secondary heat exchanger in each pack. The heat exchangers are installed in the left and right air-conditioning equipment tunnels.

   B. Access to the heat exchangers is through the nosewheel well side walls.

      (1) Access to the primary heat exchanger is through the water separator access door and the opening in the aft nosewheel well side walls.

(2) Access to the secondary heat exchanger is through the forward nosewheel well side walls.

C. Removal and installation for the right and left heat exchangers are identical, with any difference noted in the applicable step.

2. Preparation for Heat Exchanger Removal

A. Place applicable pack switch in the systems engineer control panel to off position.

B. Open applicable circuit breakers located on EPC circuit breaker panel:

	Circuit Breaker	Panel Section
	Pack cooling fan control	Heat, vent, and ice protection (ac bus)
	Pack control	Heat, vent, and ice protection (dc bus)
R	Pack trip	Battery direct bus (dc bus)
	Water separator 35°F Control	Heat, vent, and ice protection (ac bus)
	Pack compressor temperature indicator	Heat, vent, and ice protection (dc bus)

C. Remove attach screws from access panel and remove panel.

D. Remove water separator for primary heat exchanger removal (see 21-55-3).

E. Remove V-band couplings from pneumatic air duct and move duct for access to heat exchanger.

3. Removal/Installation Heat Exchanger (See Figure 401)

A. Remove Secondary (Fwd) Heat Exchanger

(1) Remove ram air plenum.

(a) Remove duct clamps from flexible duct connecting ram air plenums and remove duct.

(b) Remove duct clamps from flexible duct connecting ram air plenum to ram air duct.

(c) Disconnect two cables from heat exchanger links.

(d) Remove screws which attach ram air plenum to heat exchanger.

(e) Lower ram air plenum from plenum mounting guide then remove plenum.

(2) Remove heat exchanger.

(a) Remove V-band couplings securing ducts to heat exchanger (two at forward plenum, one at aft plenum).

(b) Remove V-band couplings connecting heat exchangers to check valve.

(c) Remove check valve and duct.

(d) Remove heat exchanger lower mounting bolts.

(e) While supporting heat exchanger, remove upper heat exchanger mounting bolt then remove heat exchanger.

B. Remove Primary (Aft) Heat Exchanger

(1) Remove ram air plenum.

(a) Remove duct clamps from flexible duct connecting ram air plenums and remove duct.

(b) For left heat exchanger removal, remove duct clamp from flexible duct connecting ram air plenum to emergency ram air duct.

(c) Disconnect two cables from heat exchanger links.

(d) Remove screws which attach ram air plenum to heat exchanger.

(e) Lower ram air plenum from plenum mounting guide then remove plenum.

(2) Remove heat exchanger.

(a) Remove V-band couplings securing ducts to heat exchanger (one at forward plenum, one at aft plenum).

(b) Remove V-band couplings connecting heat exchangers to check valve.

(c) Remove check valve and duct.

(d) Remove heat exchanger lower mounting bolts.

(e) While supporting heat exchanger, remove upper heat exchanger mounting bolt then remove heat exchanger.

C. Install Secondary (Fwd) Heat Exchanger

(1) Make certain that circuit breakers in step 2.B. are open.

(2) Check heat exchanger-to-ram air exhaust louver door seal for breaks, tears or missing pieces and repair as required.

(3) Install heat exchanger.

(a) Position heat exchanger and install support tee guide pin in support bracket and install mounting bolt.

(b) Install heat exchanger lower mounting bolts.

(c) Install check valve and duct to heat exchangers with V-band couplings. Tighten V-band couplings to torque of 50 to 70 inch-pounds.

NOTE: Install check valve with direction arrow pointing forward.

(d) Install V-band couplings securing ducts to heat exchanger (one at forward plenum, one at aft plenum). Tighten V-band couplings to torque of 35 to 45 inch-pounds.

(4) Install ram air plenum.

(a) Position ram air plenum in plenum mounting guide.

(b) Secure ram air plenum, two angles and two links to heat exchanger.

(c) Connect two cables to heat exchanger links.

(d) Install duct clamps to flexible duct connecting ram air plenums.

(e) Install duct clamps to flexible duct connecting ram air plenum to ram air duct.

D. Install Primary (Aft) Heat Exchanger

(1) Make certain that circuit breakers in step 2.B. are open.

(2) Check heat exchanger-to-ram air exhaust louver door seal for breaks, tears or missing pieces and repair as required.

(3) Install heat exchanger.

(a) Position heat exchanger and install support tee on support bracket guide pin and install mounting bolt.

(b) Install heat exchanger lower mounting bolts.

(c) Install check valve and duct to heat exchangers with V-band couplings. Tighten V-band couplings to torque of 50 to 70 inch-pounds.

NOTE: Install check valve with direction arrow pointing forward.

(d) Install V-band couplings securing ducts to heat exchanger (one at forward plenum, one at aft plenum). Tighten V-band couplings to torque of 35 to 45 inch-pounds.

(4) Install ram air plenum.

(a) Position ram air plenum in plenum mounting guide.

(b) Secure ram air plenum, two angles and two links to hea. exchanger.

(c) Connect two cables to heat exchanger links and tighten handtight.

(d) Install duct clamps to flexible duct connecting ram air plenums.

(e) Install duct clamp to flexible duct connecting ram air plenum to emergency ram air duct.

E. Install V-band couplings to pneumatic air duct. Tighten V-band couplings to torque of 35 to 45 inch-pounds.

F. Install water separator for primary heat exchanger installation (see 21-55-3).

4. Test Heat Exchanger Installation

A. Provide electrical power.

B. Check that all air conditioning and pneumatic systems circuit breakers are closed (see 21-00).

C. Pressurize pneumatic system (see Chapter 36).

D. Open entry door or flight compartment window.

‾. Move applicable pack switch to on.

F. Check for leakage at all couplings disturbed during removal/installation. Diffused leakage is allowed, jet blasts are not.

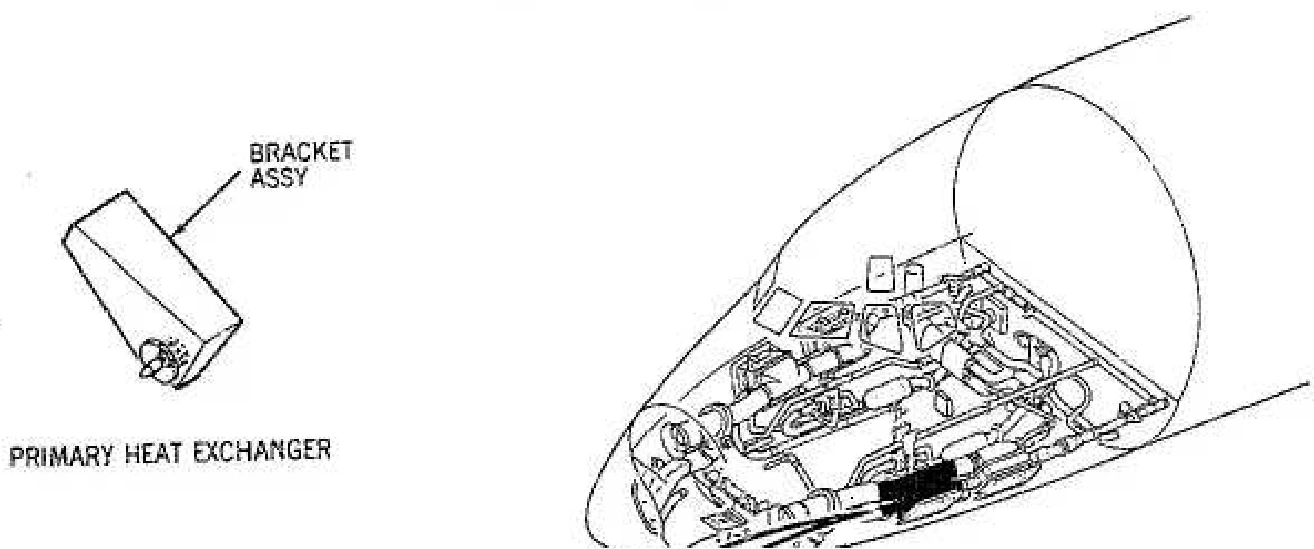
WARNING: DO NOT ATTEMPT TO REPAIR JET BLAST LEAKAGE WITH PACKS ON OR PERSONNEL MAY BE I'JURED.

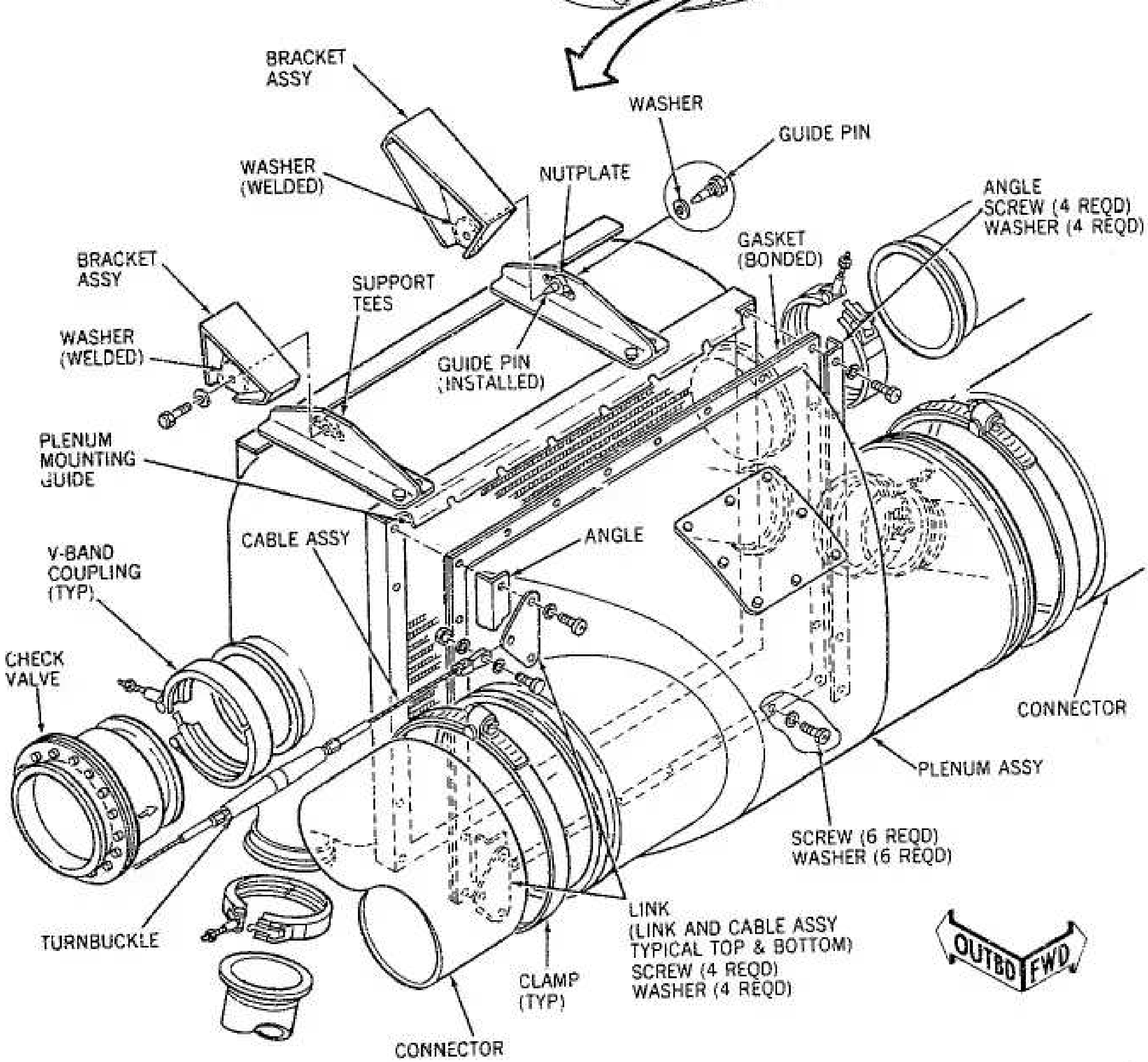
G. Move pack switch to OFF.

H. Remove pneumatic pressure if no longer required.

I. Remove electrical power if no longer required.

J. Install access panel.

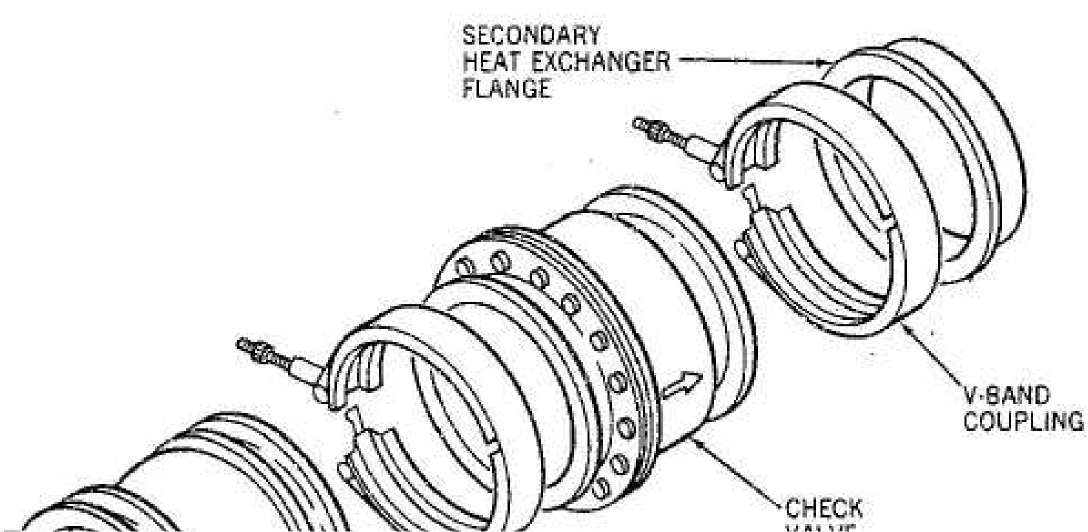


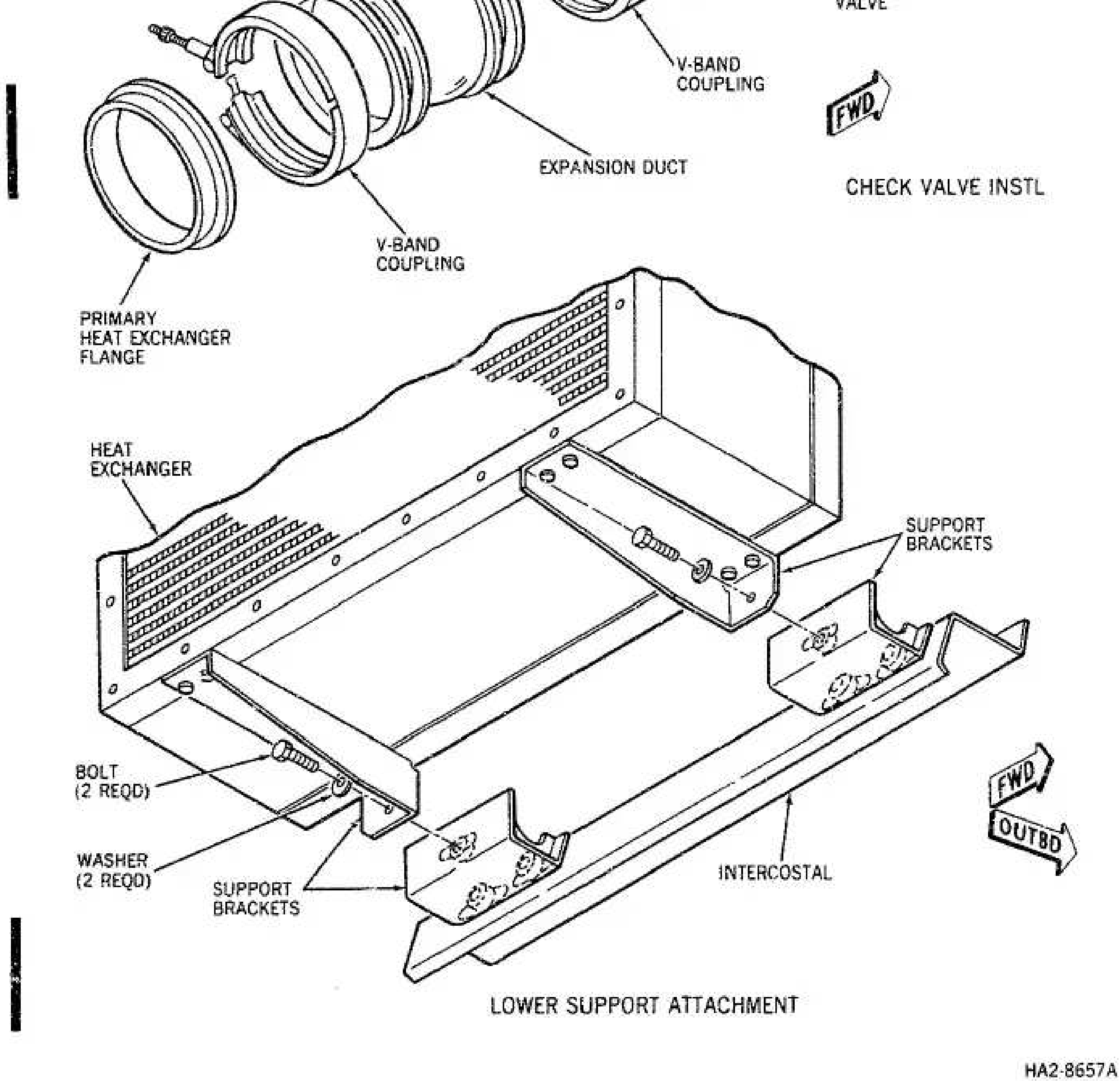


HEAT EXCHANGER INSTALLATION
SECONDARY SHOWN — PRIMARY SIMILAR

HA2-8656

Heat Exchanger Installation
Figure 401 (Sheet 1)





Heat Exchanger Installation
Figure 401 (Sheet 2)

HEAT EXCHANGER - APPROVED REPAIR

1. General

   A. Heat exchanger repair is limited to minor repair of the heat exchanger-to-ram air duct seal. Such repair is limited to replacement of short segments of the seal. Cuts, nicks, .r gouges that do not remove material completely across width of seal need not be repaired.

   B. Repair of the heat exchanger-to-ram air duct seal consists of removing the damaged part of the seal and installing a new section of seal. The replacement seal is cut from silicone sponge rubber, 0.125 inch thick.

2. Equipment and Material

A. Silicone sponge rubber, 0.125 inch thick (as required)

B. Methyl-ethyl-ketone

C. Toluene

D. Primer, Dow-Corning, RTV 1200

E. Adhesive, Dow-Corning, Q-3-0121

F. Wood or plastic scraper, knife, or sharp spatula

3. Repair Heat Exchanger

A. Remove heat exchanger (see 21-55-2 Heat Exchanger - Removal/Installation).

B. Remove damaged section of seal with knife, scraper, or spatula. Trim remaining seal to cleanup.

NOTE: Toluene may be used to soften damaged seal and adhesive during removal and cleanup.

C. After scraping, remove remaining fragments of seal with fine emery cloth.

NOTE: Cleanup with emery paper should be done manually. Use of power tools is not recommended.

D. Wipe cleaned area of ram air duct flange with methyl-ethyl-ketone and wipe dry immediately.

E. With ram air duct clean and dry, apply a liberal coat of RTV 1200 primer. Allow primer to dry for 30 minutes.

F. Apply a uniform coating of Q-3-0121 adhesive on cleaned and primed area.

G. Install replacement segment of seal as soon as possible after applying adhesive.

NOTE: Exposure to air for only a few minutes will cause adhesive to form a skin which will prevent proper bonding of seal to fiberglass.

H. Install heat exchanger. See 21-55-2, Heat Exchanger - Removal/Installation.

NOTE: The installed heat exchanger will provide the seal compression necessary to obtain a good bond between seal and ram air duct.

TOC

WATER SEPARATOR - MAINTENANCE PRACTICES

1. General

A. One water separator is provided for each cooling pack. Since left and right water separator installations are alike, the following procedure will apply to either.

B. Access to water separator is through nosewheel well side walls.

2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Fabric detergent			Clean coalescer (bag)
B	Washing machine			Clean coalescer (bag)
C	Dry cleaning solvent		Stoddard	Clean oily or greasy coalescer (bag)
D	Grease	High vacuum -40° to 400°F	Dow Corning Corp.	Installation of coalescer (bag)

3. Removal/Installation Water Separator (See Figure 201)

A. Remove Water Separator

(1) Open applicable water separator 35°F control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Remove 35°F temperature sensor electrical connector.

(3) Unscrew 35°F temperature sensor from mounting boss and retain for installation on new water separator.

(4) Disconnect drain tube.

(5) Remove duct clamps.

(6) Support water separator and loosen support clamp.

(7) Remove water separator.

B. Install Water Separator

(1) Using new gasket, install 35°F temperature sensor.

(2) Position water separator on support with arrow pointer aft and loosely clamp water separator.

(3) Loosely clamp ducts to water separator.

(4) Rotate water separator to position shown in figure 201.

(5) Check that drain tube and fittings are not blocked then install drain tube on water separator.

(6) Tighten water separator support and duct clamps.

(7) Provide electrical power.

(8) Close applicable water separator 35°F control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(9) Check that 35 degrees control valve is open.

(10) Open water separator 35°F control circuit breaker.

(11) Connect electrical connector to 35°F temperature sensor.

(12) Close water separator 35°F control circuit breaker.

(13) Check that 35-degree control valve modulates.

(14) Pressurize pneumatic system (see Chapter 36).

(15) Move applicable pack switch to on.

(16) Check for leakage at duct to water separator joints. Diffused leakage allowed, jet blasts are not.

(17) Move pack switch to off.

(18) Remove pneumatic pressure if no longer required.

(19) Remove electrical power if no longer required.

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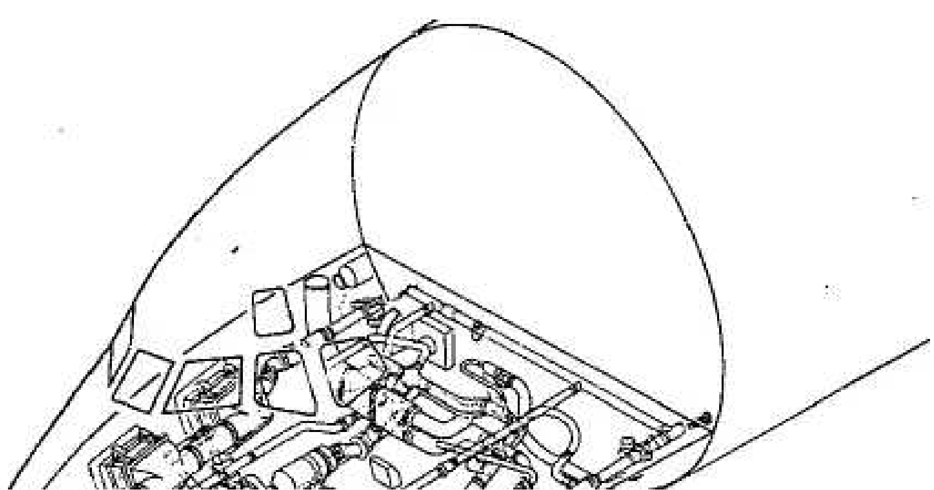
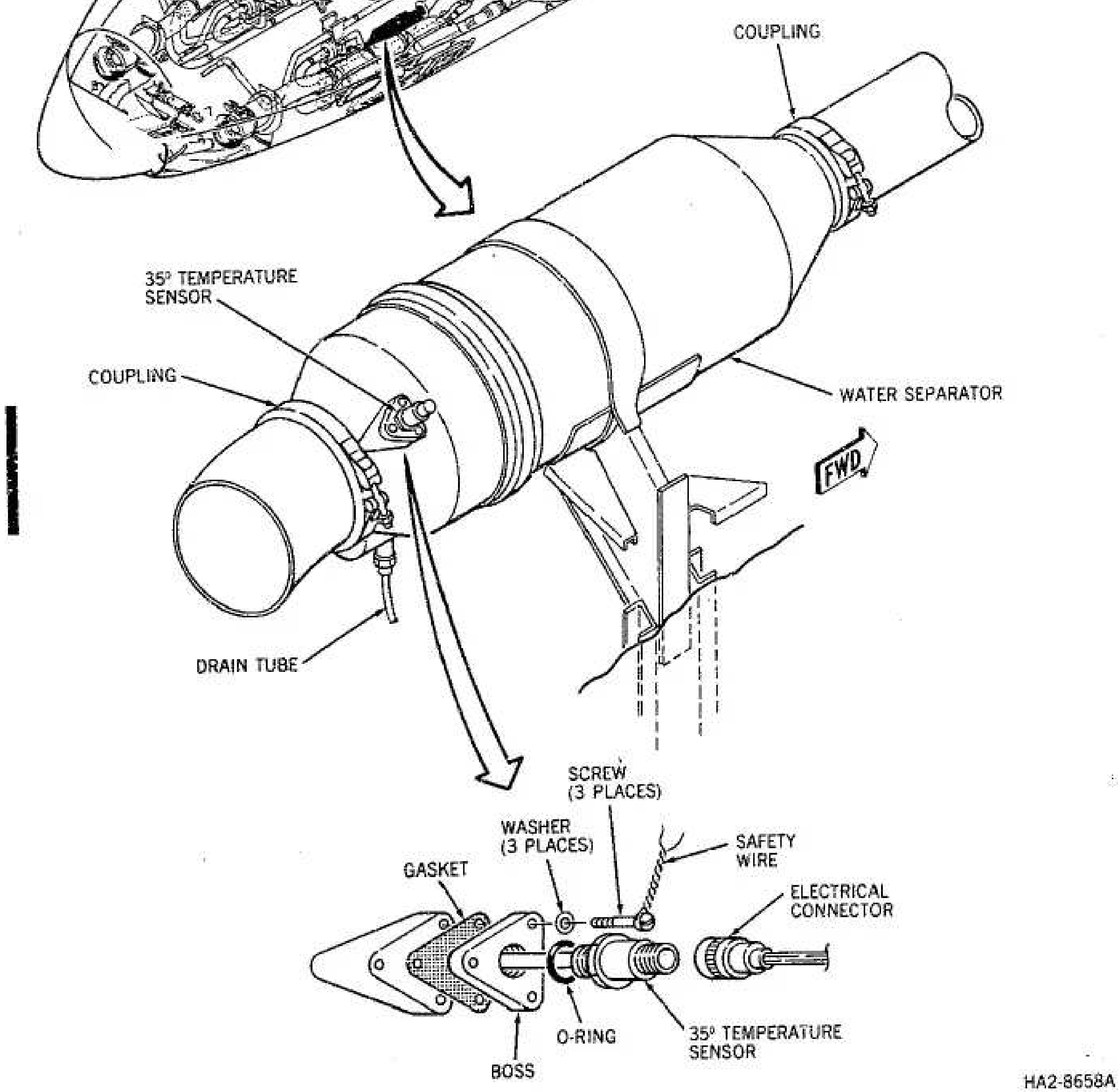
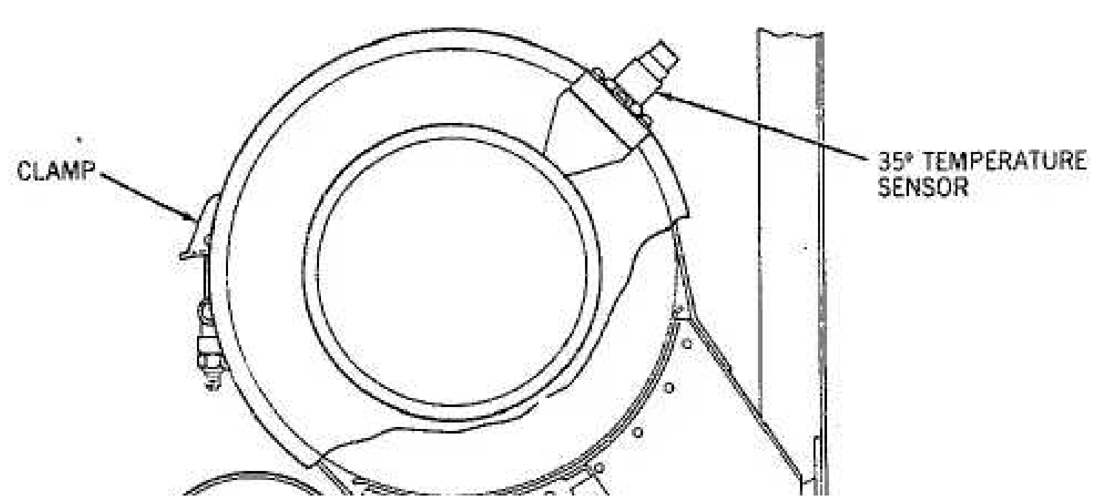
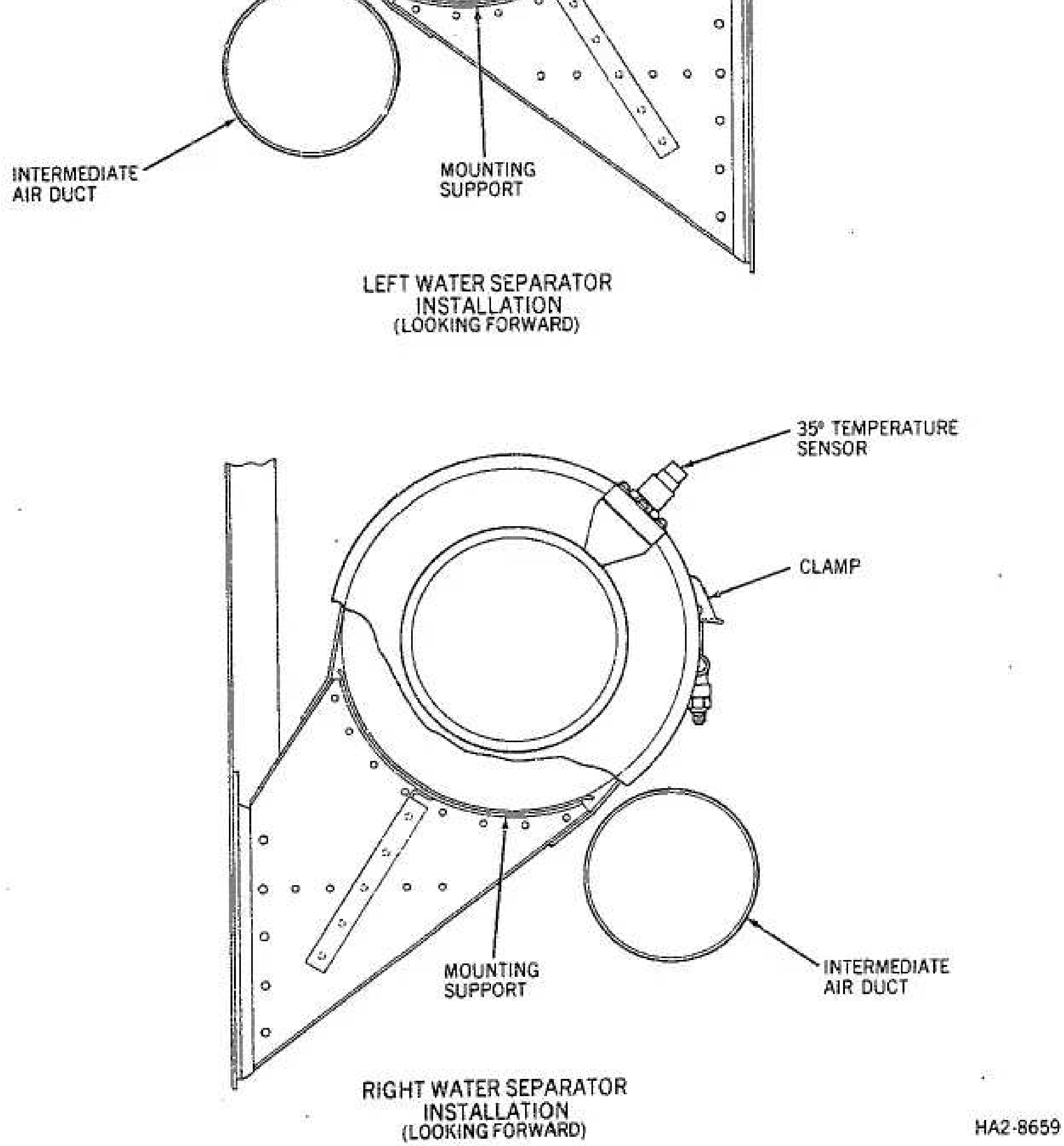




Water Separator Installation
Figure 201 (Sheet 1)





Water Separator Installation
Figure 201 (Sheet 2)

4. Removal/Installation Water Separator Coalescers (Bag) (See Figure 202)

   A. General

      (1) Water separator coalescer (bag) is positioned around bag support and secured at each end by a bead chain assembly and two springs.

   B. Remove Water Separator Bag

      (1) Remove water separator.

      (2) Remove clamp holding water separator shell assembly to collector chamber.

      (3) Remove collector chamber from shell assembly.

(3) Remove collector chamber from shell assembly.

(4) Remove bag support and bag from shell assembly.

(5) Remove spring-loaded chain retaining ring from aft end of bag.

(6) Slide bag from bag support.

C. Prepare Bag for Installation

(1) If bag is new, retaining spring-chain may not be installed through hem at large diameter end of bag. On bags without spring-chain installed, a string is provided for installation of spring-chain. Tie one end of chain to string and pull chain through hem.

(2) Attach ends of chain together with spring and remove string.

D. Install Water Separator Bag

(1) Check that louvers of bag support are clean, then slide new bag over support and install retaining ring.

NOTE: If bag has napped side, install with napped side out.

(2) Visually check both O-ring gaskets for damage and indication of permanent set. Replace gaskets as necessary.

(3) Check inlet shell assembly and collector chamber for cleanliness. Remove any material which may plug drain.

(4) Locate O-ring gasket in shell assembly groove.

(5) Install bag assembly into shell.

(6) Install O-ring gasket in collector chamber groove.

NOTE: It may be necessary to lightly grease O-ring gasket to keep gasket in groove during installation. Wipe off excess grease.

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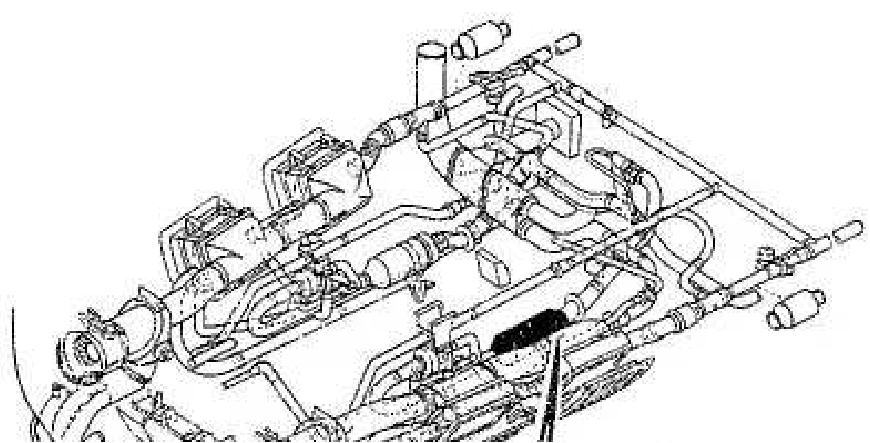

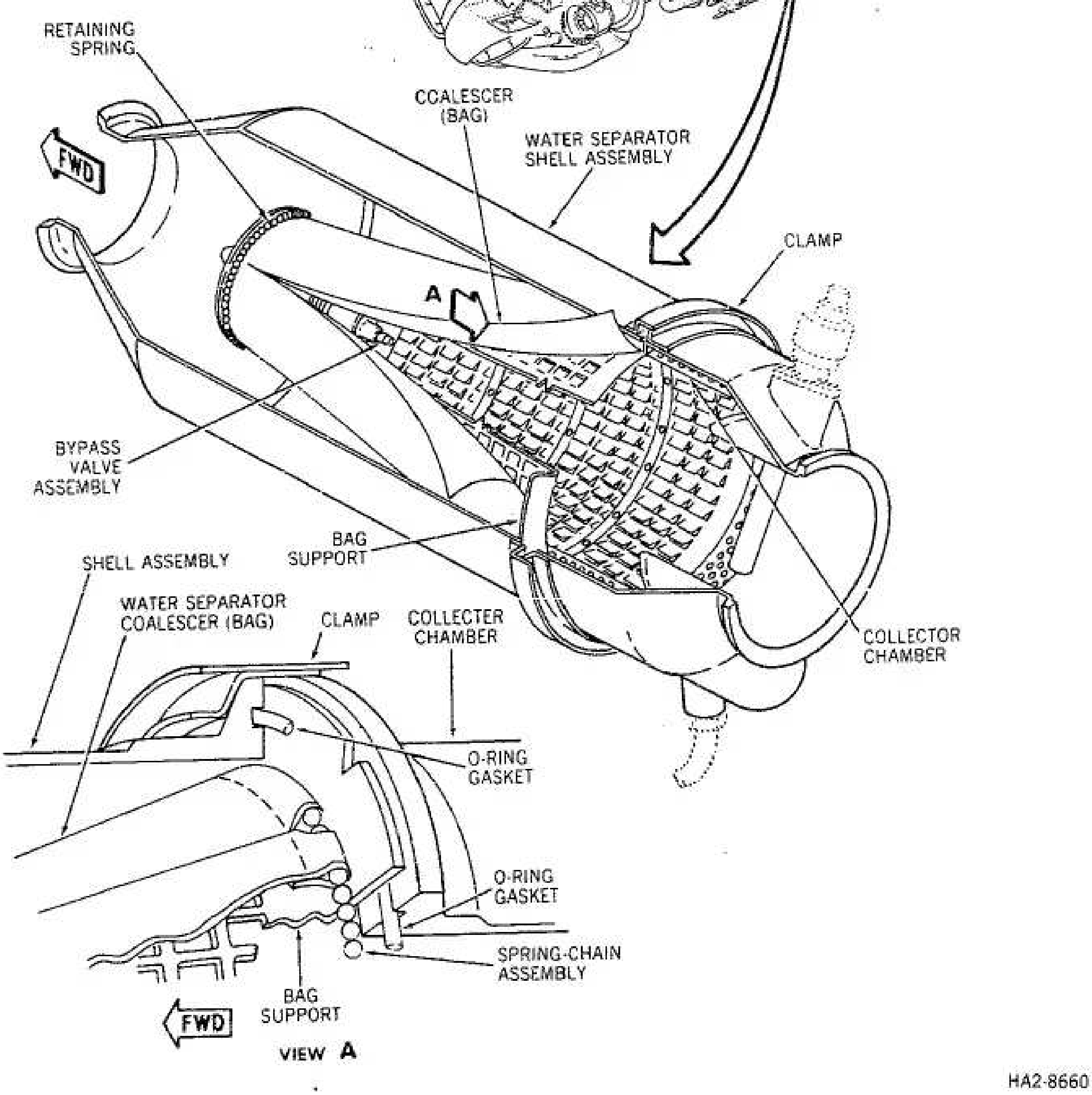

Water Separator Coalescer Installation
Figure 202

TOC

(7) Place collector chamber on shell assembly.

NOTE: Be careful not to disturb O-ring gasket and keep bag support centered as much as possible in shell.

(8) Install clamp holding shell to collector assembly.

(9) Install water separator.

5. Cleaning Water Separator Coalescer (Bag)

A. General

(1) Water separator coalescers (bags) may be cleaned for re-use if dirtiness is only cause for removal from the water separator.

(2) Two cleaning steps are provided. First step need not be used unless removed bag is contaminated with oil or grease.

B. Clean Water Separator Bag

(1) Remove separator bag from water separators (see paragraph 4).

(2) Visually examine bag for oil or grease contamination. If bag appears oily or greasy proceed to step B.(3)(a) if no appearance of oil or grease proceed to step B. (3)(b).

(3) Wash separator bag.

(a) Immerse bag in cleaning solvent and gently rub greasy spots, then remove from solvent.

(b) Place bag in washer loaded with water and fabric detergent and wash for one normal cycle.

(c) Check that no dry cleaning solvent odor exists. If objectionable odor exists wash for another cycle.

(4) Install water separator bag (see paragraph 4).

35°F CONTROL VALVE - REMOVAL/INSTALLATION

1. General

A. A 35°F control valve is provided for each cooling pack. Right or left 35°F control valve removal/installation is the same. Position of valve at installation is slightly di(erent. Any difference in procedure is noted in step involved.

B. Access to the 35°F control valve is through nosewheel well side walls.

2. Removal/Installation 35°F Control Valve (See Figure 401)

A. Remove 35°F Control Valve

(1) Open applicable water separator 35°F control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Disconnect electrical connector from valve.

(3) Disconnect bonding jumper from valve.

(4) Remove V-band clamps which hold valve in place.

(5) Remove valve.

B. Install 35°F Control Valve

(1) Check that new valve's position indicator shows closed and that valve is closed.

(2) Locate valve between duct ends and install V-band clamps. Do not tighten clamps.

NOTE: For left 35° control valve installation, install valve with motor actuator side of valve rotated inboard 20 $\pm$10°; for right side, install valve with motor actuator side of valve rotated inboard 20 $\pm$10°.

(3) Tighten clamps installed in step B.(2).

(4) Connect bonding jumper to valve.

(5) Connect electrical connector to valve.

(6) Provide electrical power.

(7) Close applicable water separator 35°F control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(8) Perform BITE test per instructions shown above the related 35°F controller.

(9) Remove electrical power if no longer required.

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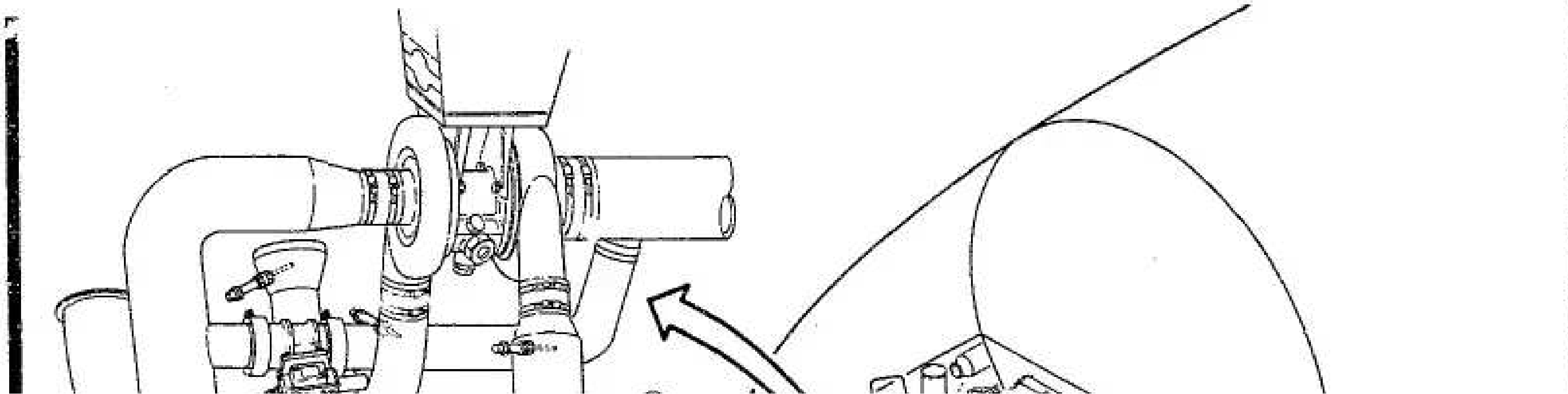

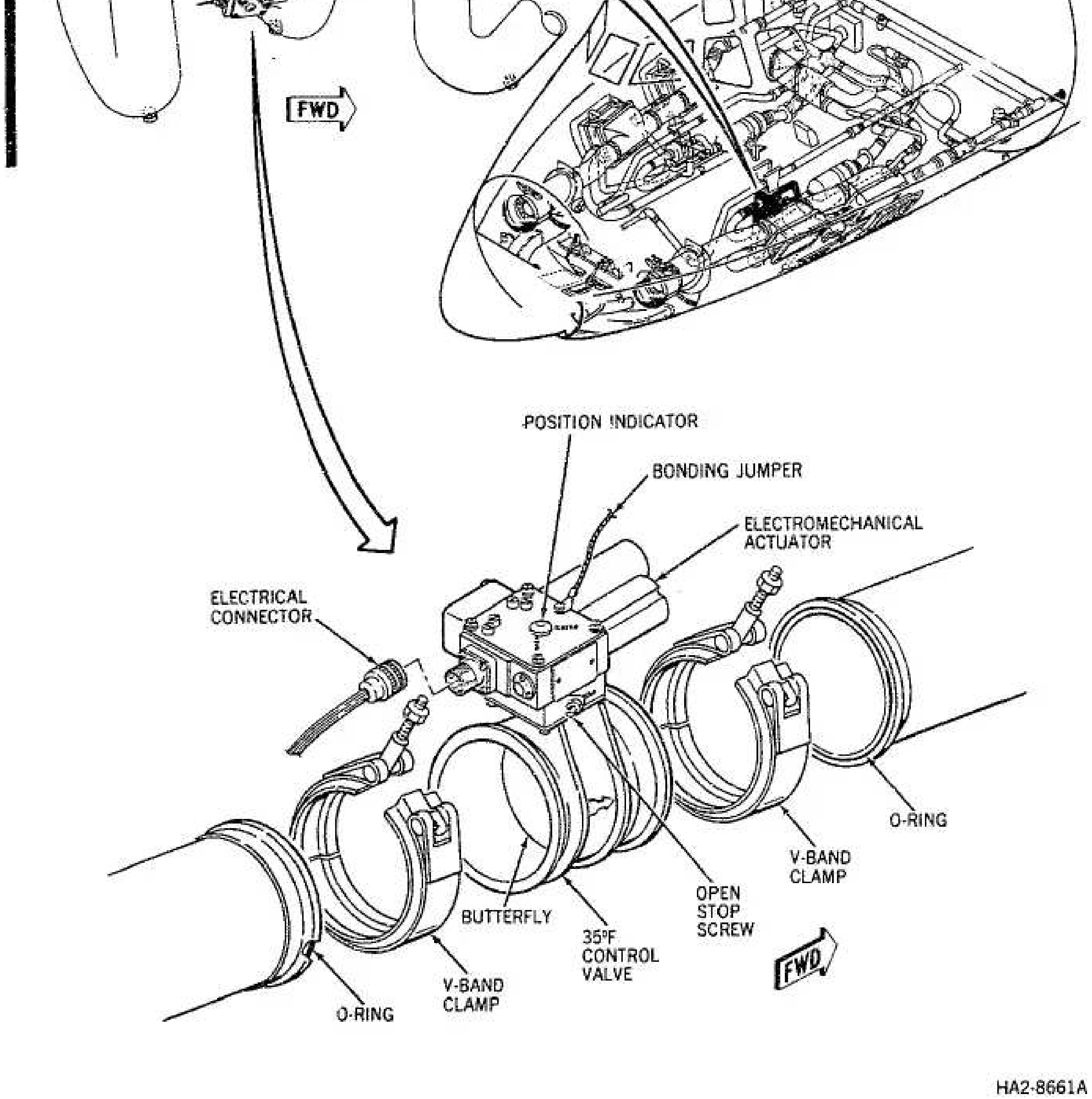

35°F Control Valve Installation
Figure 401

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PACK SHUTOFF AND FLOW CONTROL VALVE - REMOVAL/INSTALLATION

1. General

A. A pack shutoff and flow control valve is provided for each air conditioning cooling pack and is installed in the bleed air duct from the engines. The valve provides selectable fl w and pack shutoff capabilities.

B. Access to the pack shutoff and flow control valve is through the air-conditioning accessory compartment lower fuselage access doors.

C. The following procedure is for both with any difference noted in the appli- cable step.

2. Removal/Installation Pack Shutoff and Flow Control Valve

A. Remove Pack Shutoff and Flow Control Valve

(1) Verify pneumatic manifolds are not pressurized.

(2) Open applicable pack control circuit breaker, located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker panel.

(3) Remove electrical connectors from valve actuator.

(4) Disconnect overboard sense line from actuator.

(5) Loosen coupling clamp at each end of valve body and slide clamps onto connecting ducts. Remove valve.

B. Prepare to Install Pack Shutoff and Flow Control Valve

(1) Clean surface of actuator bonding tab with fine sandpaper or emery cloth to obtain bright surface over entire contact area of tab.

(2) Remove shipping caps from electrical receptacles and from each end of valve body.

NOTE: Shipping caps should be installed on valve removed from airplane.

C. Install Pack Shutoff and Flow Control Valve

(1) Make certain applicable pack control circuit breaker, located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker panel, is open.

(2) Position valve in duct with actuator inboard and position coupling clamps to support valve. Flow arrow must point toward heat exchanger.

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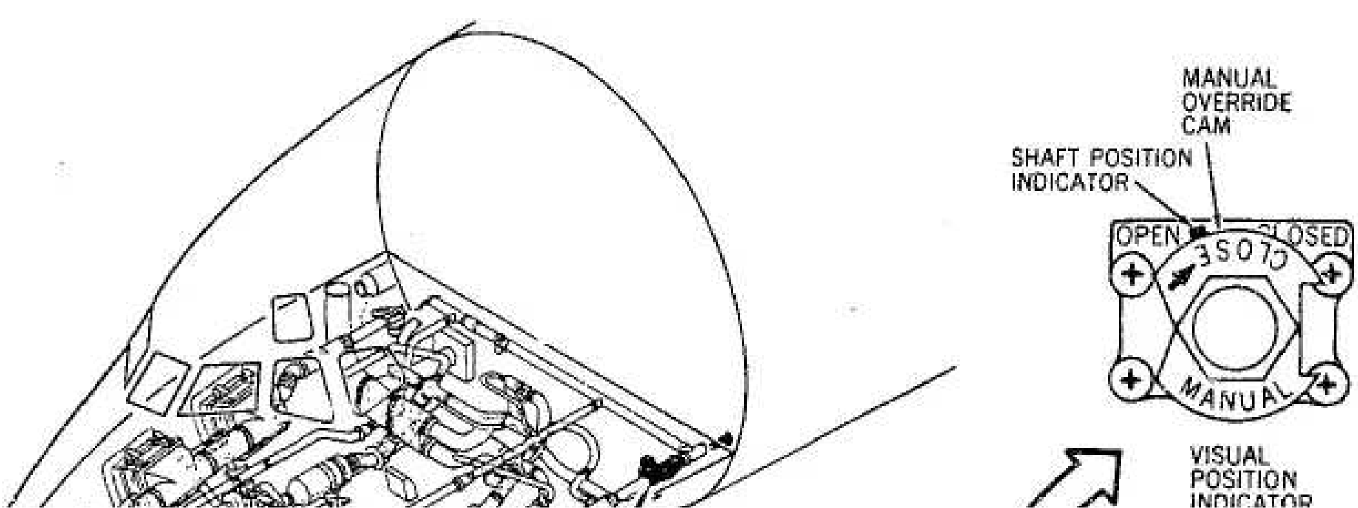

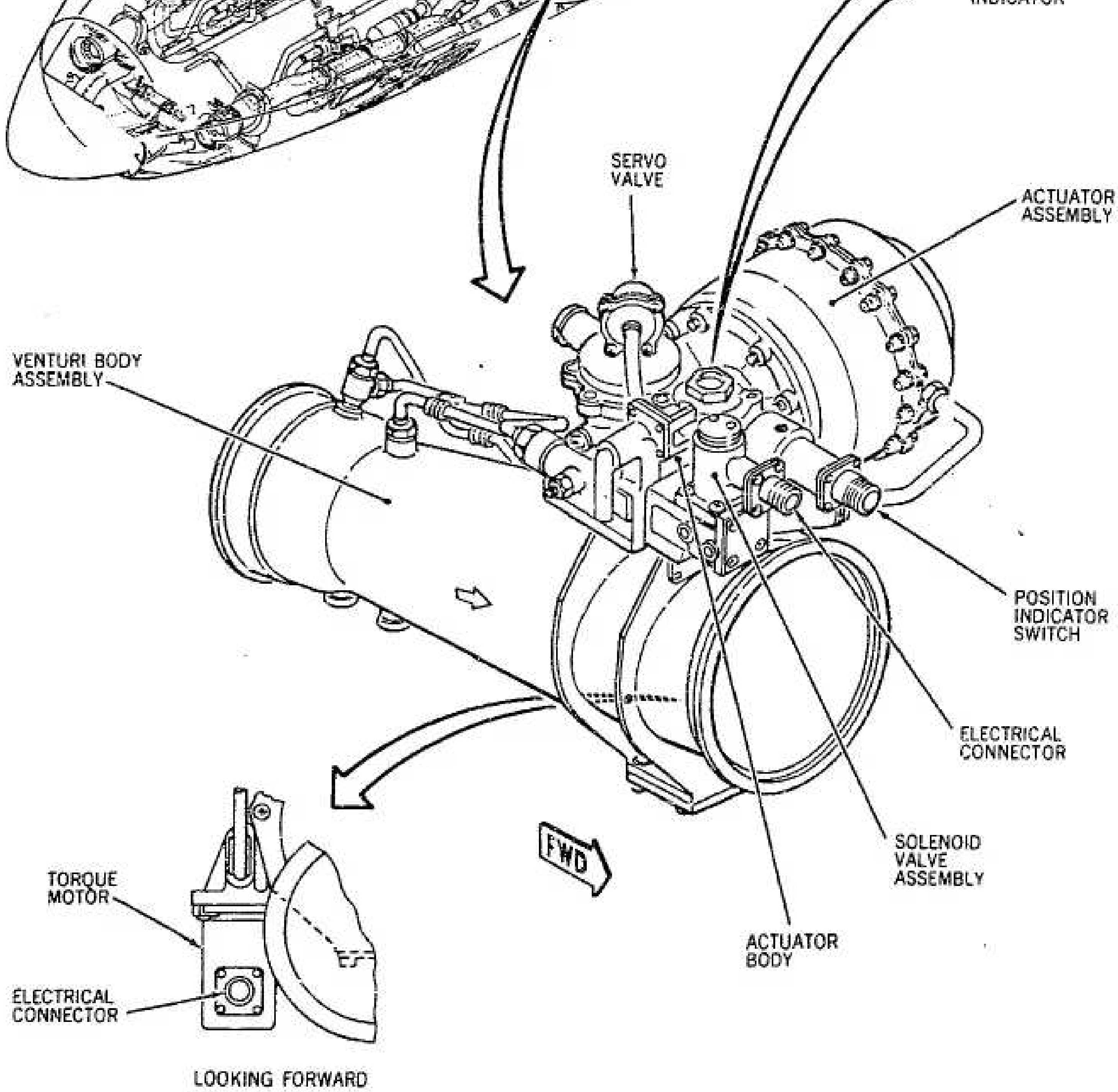

HA2-8662A

Pack Shutoff and Flow Control Valve -- Installation
Figure 401

(3) Connect sense line to actuator.

(4) Check that clearance between actuator and other components or structure is not less than 0.25 inch. Tighten both coupling clamps.

(5) Connect bonding jumper.

(6) Install electrical connectors on valve actuator.

(7) Close applicable pack control circuit breaker, located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker panel.

(8) Check pack shutoff and flow control valve installation (see paragraph 3).

3. Test Pack Shutoff and Flow Control Valve Installation

A. Provide electrical power.

B. Check that all air conditioning and pneumatic systems circuit breakers are closed (see 21-00) and left and right pack switches are in off position.

C. Pressurize pneumatic system (see Chapter 36).

D. Open entry door or flight compartment window.

E. Move applicable pack switch to on. Check that valve position indicator moves to open.

F. Check for leakage at all couplings disturbed during removal/installation. Diffused leakage is allowed, jet blasts are not.

WARNING: DO NOT ATTEMPT TO REPAIR JET BLAST LEAKAGE WITH PACKS ON OR PERSONNEL MAY BE INJURED.

G. Slowly rotate flow selector from max to min and check that the valve position indicator moves slightly towards closed as result of each position selected.

H. Move pack switch to OFF. Check that valve position indicator moves to closed.

I. Remove pneumatic pressure if no longer required.

J. Remove electrical power if no longer required.

35°F TEMPERATURE SENSOR - REMOVAL/INSTALLATION

1. General

A. One 35°F temperature sensor is provided for each cooling pack. Since the left and right 35°F sensor installations are alike, the following procedure will apply to either.

B. Access to the 35°F temperature sensor is through the nosewheel well side walls.

2. Removal/Installation 35°F Temperature Sensor (See Figure 401)

A. Remove Temperature Sensor

(1) Open applicable water separator 35°F control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Disconnect electrical connector from 35°F temperature sensor.

(3) Unscrew 35°F temperature sensor from mounting sensor boss and remove sensor.

B. Install Temperature Sensor

(1) Using a new O-ring screw 35°F temperature sensor into sensor boss.

(2) Provide electrical power.

(3) Close applicable water separator 35°F control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(4) Perform BITE test per instructions shown above the related 35°F controller.

(5) Remove electrical power if no longer required.

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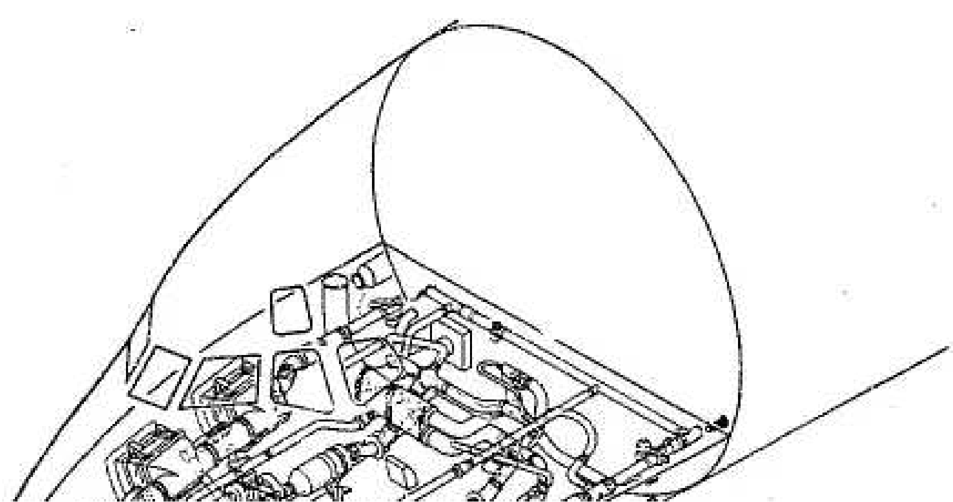

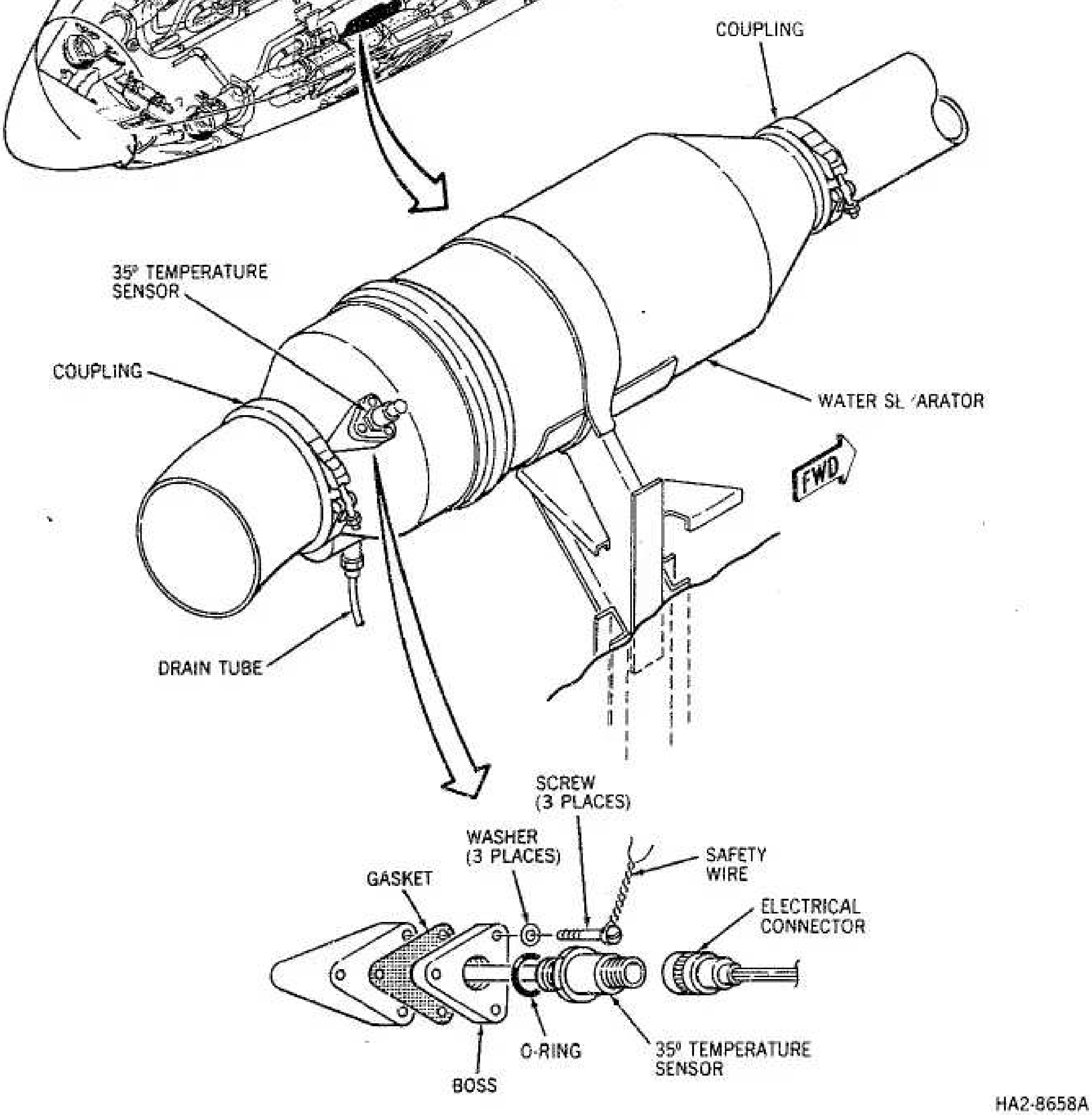

35°F Temperature Sensor--Installation
Figure 401

35°F CONTROL - MAINTENANCE PRACTICES

1. General

   A. One 35°F control is provided for each cooling pack. Since left and right 35°F control installations are alike, the following procedure will apply to either.

   B. Access to 35°F control is through air-conditioning accessory compartment lower fuselage access doors.

2. Removal/Installation 35°F Control (See Figure 201)

A. Remove 35°F Control

(1) Open applicable water separator 35°F control circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Remove 35°F control electrical connector.

(3) Remove 35°F control attaching screws and remove control.

B. Install 35°F Control

(1) Position new or serviceable 35°F control and install four attaching screws.

(2) Connect 35°F control electrical connector.

(3) Test 35°F control installation.

(a) Provide electrical power.

(b) Close water separator 35°F control circuit breaker, then press the GO or NO GO light and check that light comes on.

(c) Remove electrical power if no longer required.

3. Adjustment/Test 35°F Control

A. Make certain that water separator 35°F control circuit breaker, located on heat, vent, and ice protection ac section of EPC circuit breaker panel, is closed.

B. Supply 115V AC power to all busses.

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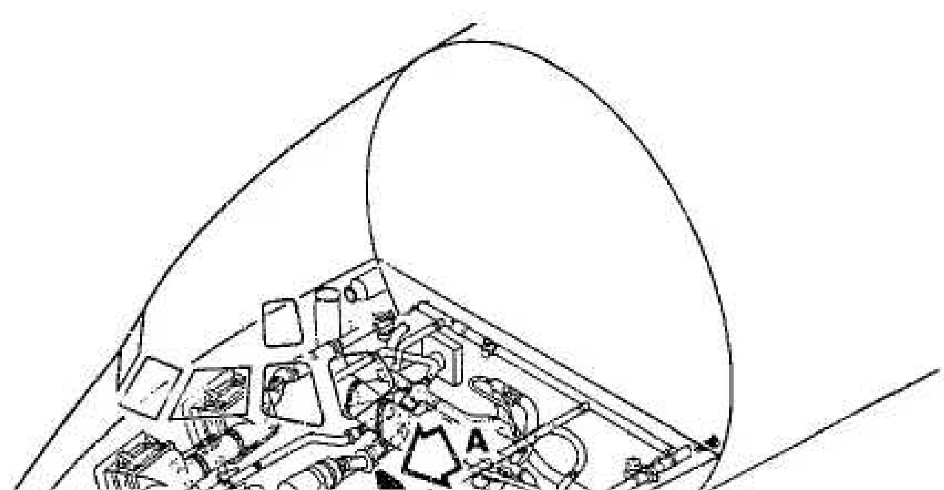

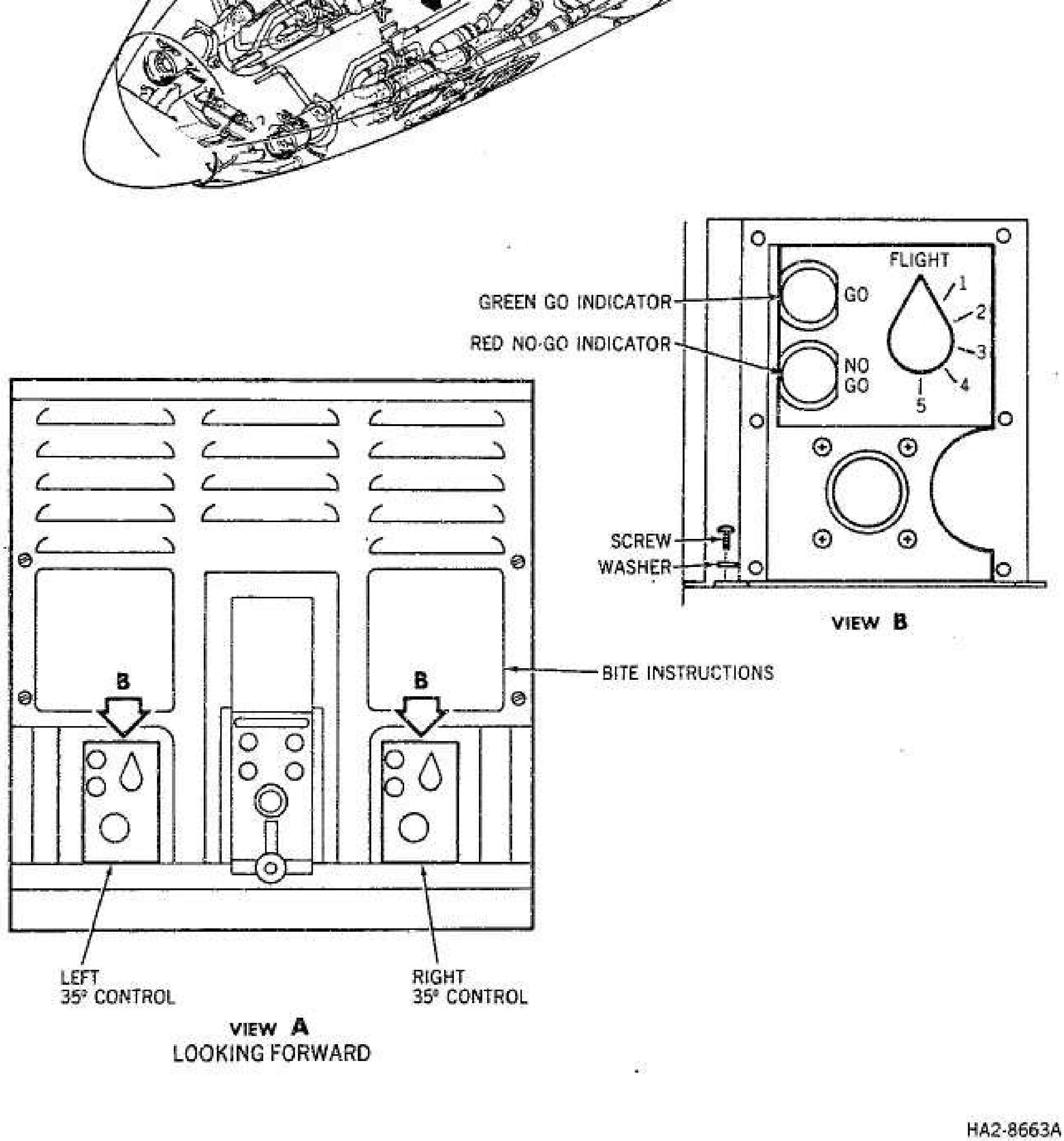

35°F Control--Installation
Figure 201

TOC

C. Operate press-to-test lamps. If both lamps fail to come on, check that 115V AC power is being applied. Replace bulb(s) if required.

D. Perform BITE test per instructions shown above controller.

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RAM AIR SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The ram air system provides for two methods of operation. During pressurized flight, ram air is used as a cooling medium for the cooling pack heat
R exchangers. A pack cooling system with a separate inlet and a ground cooling fan induces airflow through the same ducts for ground operation. A ram air system is included for each cooling pack (see Figure 1).

B. The ram air system provides a cooling medium for the air-to-air primary

and secondary heat exchangers. The heat exchangers are located so that air passing through the ram air ducts must also pass through the heat exchangers. Ram pressure forces air through the ducts during flight. On landing, a ground cooling fan automatically operates to force the air through. Cooling air is taken into the system through the ram air inlet or the ground cooling fan inlet, ducted through the primary and secondary heat exchangers and exhausted through louvers outboard of each heat exchanger. A diverter valve is located in the ram air inlet duct. During ground operation this diverter valve prevents air leaving without passing through the heat exchangers. In flight the diverter valve prevents air escaping from the system by the ground cooling fan route.

C. During flight a ram air exhaust louver door system permits adjustment of ram airflow to minimize drag. A single actuator energized by a switch on the systems engineer's control panel is mechanically connected to the secondary heat exchanger exhaust louver door, and the primary heat exchanger exhaust louver door. A temperature indicator on the systems engineer's control panel permits monitoring the temperature as the exhaust louver doors are being closed. Door control is provided for each ram air system.

D. Ram air system equipment in use during flight includes a ram air inlet, an electrical ram air exhaust louver door actuator which modulates the exhaust louver doors, switches on the systems engineer's control panel for controlling ram air exhaust louver door position, and a temperature bulb for monitoring pack temperature. Pack cooling system equipment includes a fan air inlet door, a fan air inlet door actuator, and a ground cooling fan. The ram air diverter valve may be considered pack cooling system or flight equipment.

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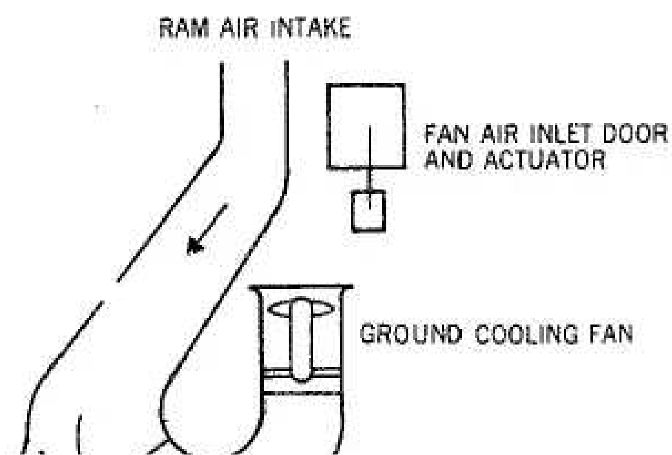

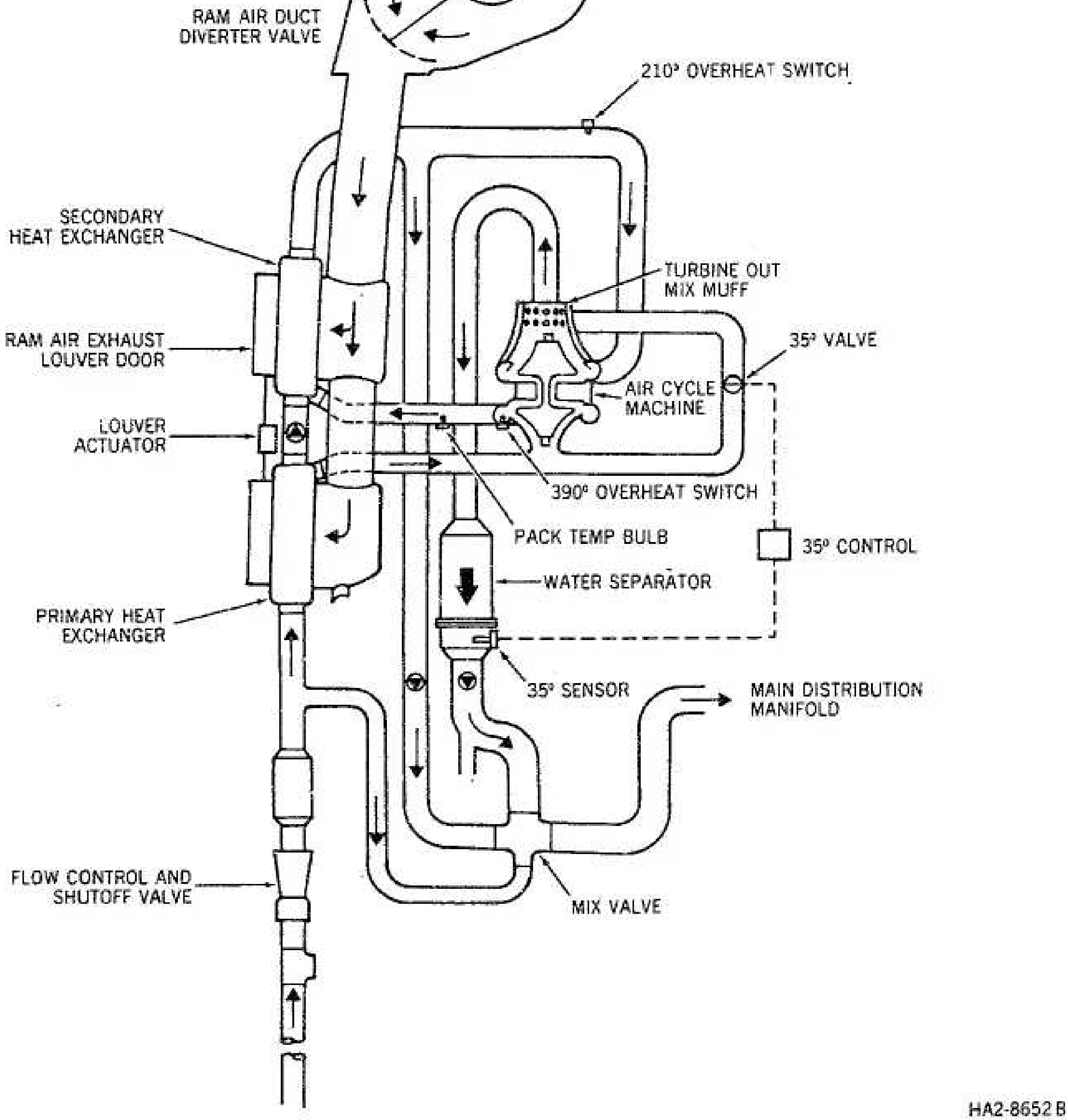

Ram Air System
Figure 1

2. Component Description (see Figure 2.)

A. Ram Air Inlet

Outside air for the air conditioning packs enters though ram airscoops located in the fuselage nose section.

B. Ram Air Exhaust Louver Door Actuator (see Figure 3.)

(1) The ram air exhaust louvc door actuator is motor-operated rotary-type unit which uses 115 volts ac. It operates in either direction and may be stopped at any in-between position. The actuator is used to position the secondary heat exchanger ram air exhaust louver door and the primary heat exchanger exhaust louver door (see Figure 3).

(2) A three position switch, momentary open, off, momentary close, on the systems engineer's control panel controls the position of the two ram air exhaust doors simultaneously. When the switch is moved to OPEN or CLOSE a circuit is completed to the actuator motor. The motor then drives an output shaft. The output shaft imparts motion to the ram air exhaust doors through a crank and rod system. When the switch is released the motor circuit is interrupted and a magnetic clutch in the motor prevents turning of the output shaft. Two limit switches, one for each direction of travel, interrupt the motor circuit when the output shaft reaches its extreme position of travel in either direction. A position potentiometer, fixed to the actuator shaft, is electrically connected to a position indicator on the systems engineer's control panel. As the actuator position changes, resistance through the potentiometer changes and the indicator needle moves according y.

C. Ram Air Exhaust Control

(1) Ram air exhaust control provides a method for reducing drag when the air conditioning system does not require maximum cooling from the heat exchangers. Separate control is provided for each ram air system (see Figure 2).

(2) Ram air exhaust louver doors are controlled by a cooling doors switch on the systems engineer's control panel. An indicator is located beside the switch to provide a method for monitoring door position. The switch controls the ram air exhaust louver door actuator. This actuator is connected to the secondary and primary heat exchanger exhaust doors by cranks and pushrods.

D. Ram Air Diverter Valve (see Figure 4)

(1) The ram air diverter valve is a three port valve incorporating a single flapper and an electrically operated actuator. One port of the valve is connected to the heat exchanger ram air duct. Another port of the valve is connected to the ram air ducting from the nose scoop. The third port
R of the valve is connected to the ground cooling fan. The flapper is
R hinged to cover either the ram air inlet port or the ground cooling fan port. The actuator has a continuous duty motor that holds the flapper against the valve seat by providing a continuous stall torque output.

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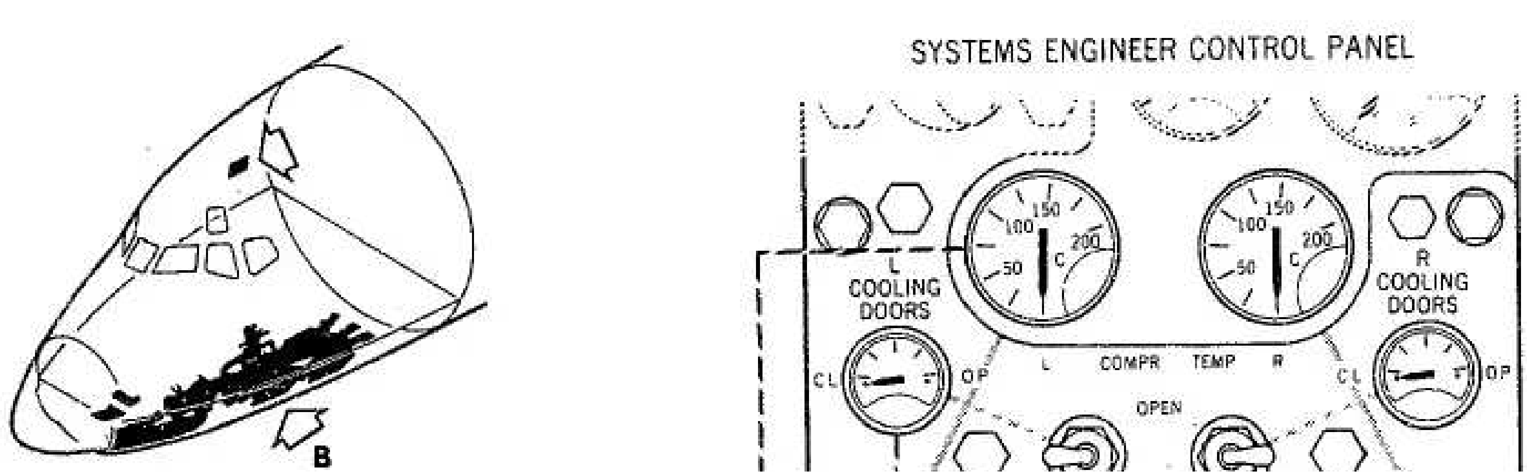

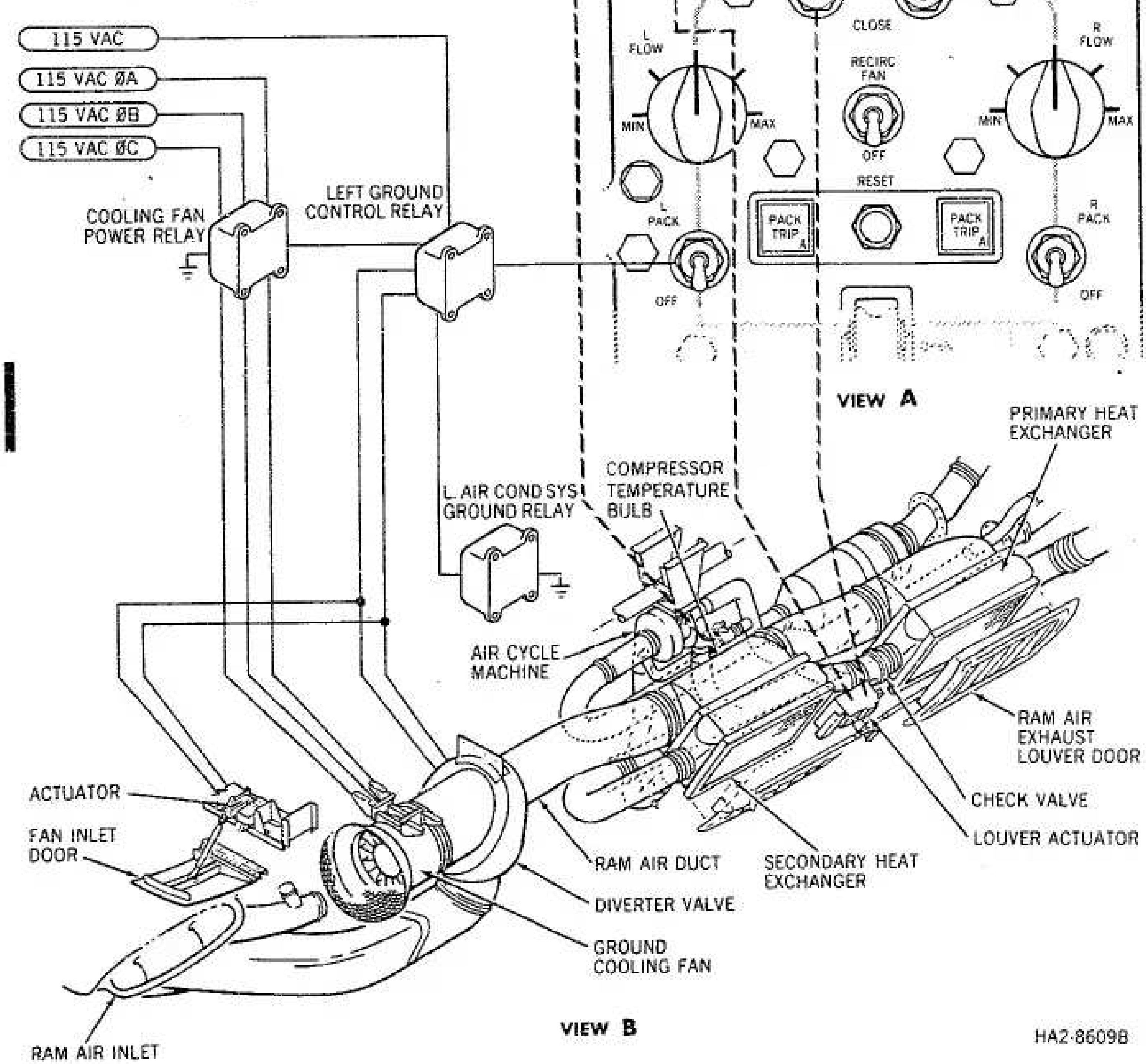

Ram Air System Equipment
Figure 2

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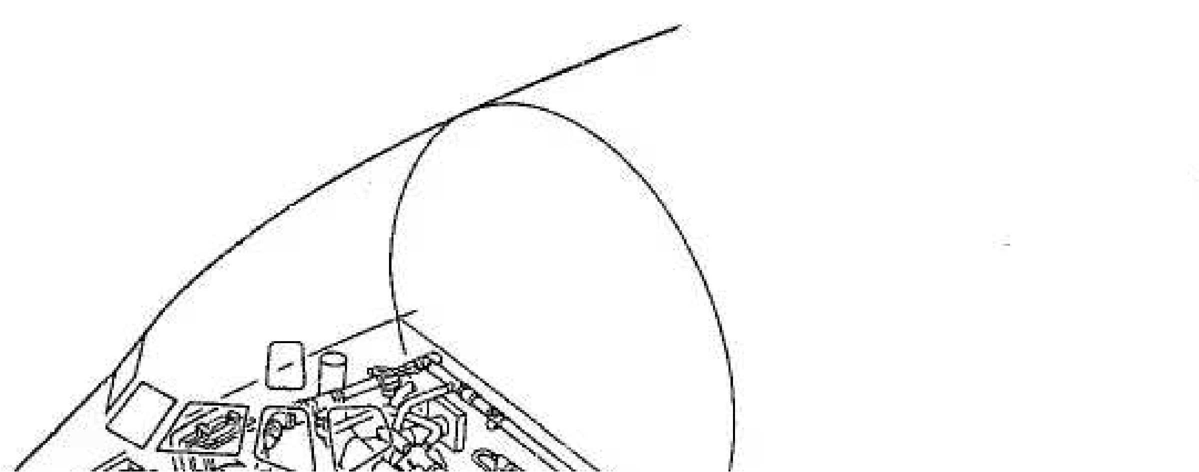

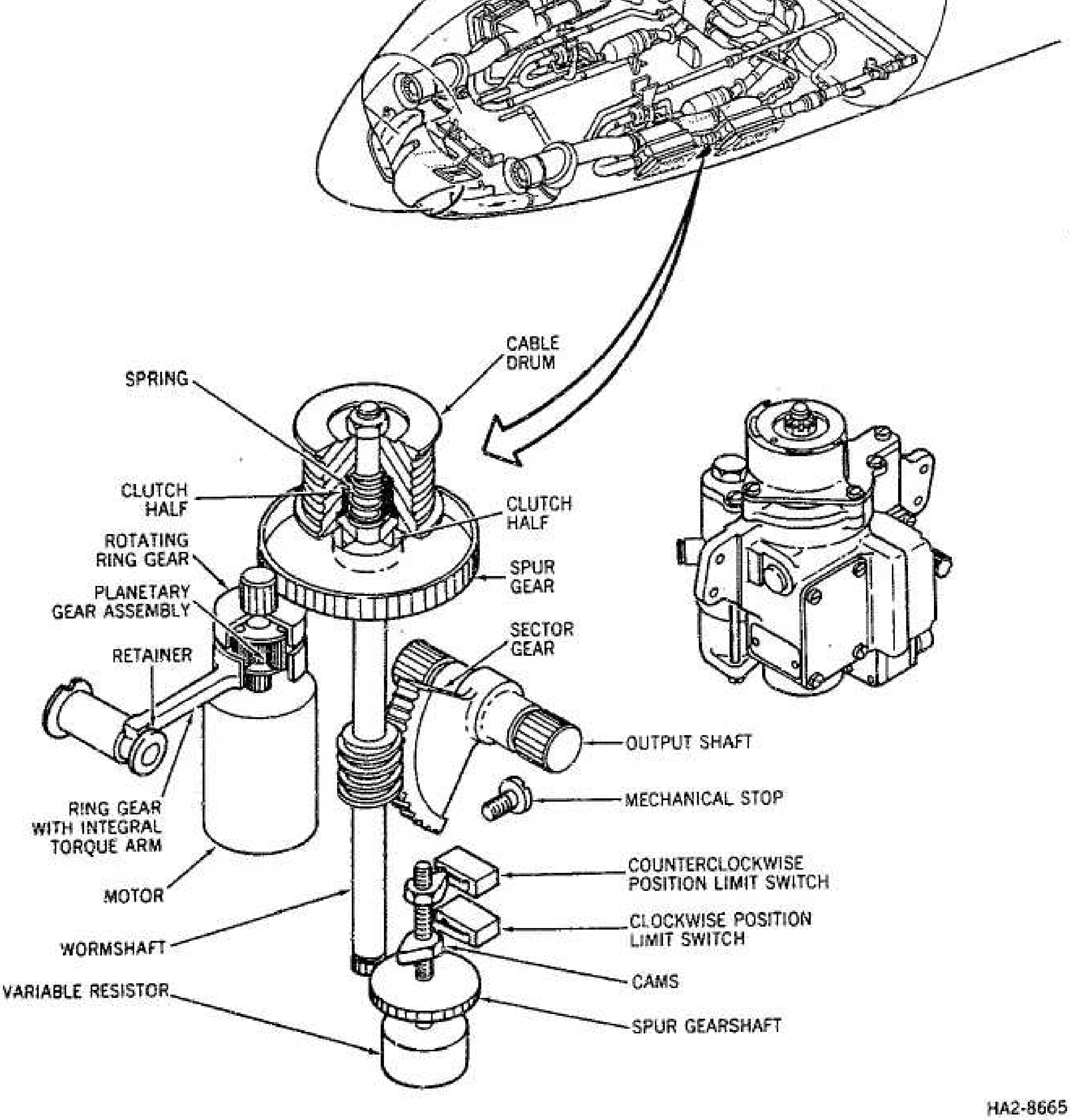

Ram Air Exhaust Louver Door Actuator -- Schematic
Figure 3

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(2) On the ground, the flapper of the air diverter valve is positioned over the ram air port and the fan port is open. The fan operates to provide ambient air through the diverter valve, over the heat exchangers, and is vented overboard through the exhaust doors. In flight, the flapper of the air diverter valve is positioned over the fan port and ram air port is open. Ram air flows from the nose scoops through the diverter valve, over the heat exchangers, and is vented overboard through the exhaust doors.

E. Ram Air Exhaust Louver Doors

(1) Two ram air exhaust louver doors operate to modulate ram air flow past the heat exchangers during flight. Both doors are moved by the ram air

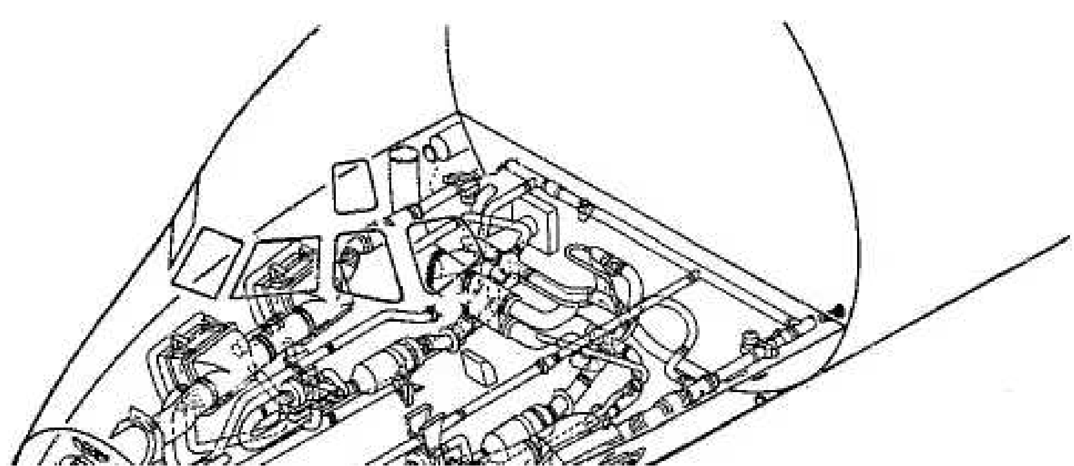
louver door actuator through a rod and crank system. Part of the cooling air, after passing through the secondary heat exchanger leaves the airplane through the secondary heat exchanger exhaust louver door. The rest of the cooling air passes through the primary heat exchanger then leaves through the primary heat exchanger exhaust louver door.

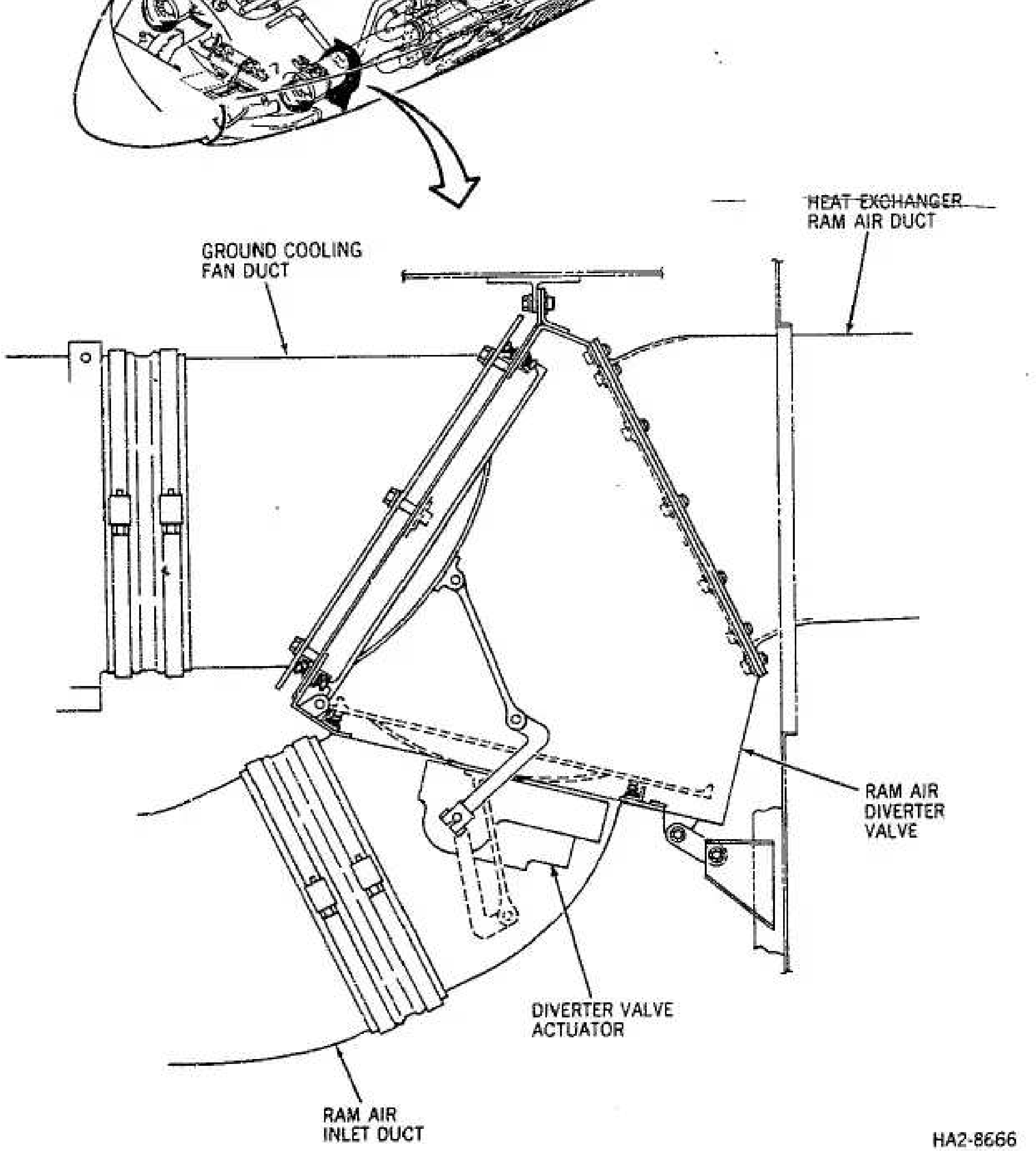
(2) Each exhaust louver door is supported by and fastened to the fuselage. The door assembly consists of a louver support frame, a support bracket assembly, spacer plate, an actuator shaft, articulating links, louver actuating links, and five louvers. When the actuator is electrically driven, a shaft is rotated that moves a linkage connected to the louvers. The louvers are connected to the fixed support frame and to the actuating link. When the actuator rotates, the link moves forward or aft to position the forward edge of each louver and regulate exhaust air flow.

R F. Ground Cooling Fan

R (1) A ground cooling fan is used in each ram air system to induce flow through the ram air ducts and heat exchangers during ground operation of the air conditioning system. The fan is installed aft of the fan air inlet door.

R (2) The ground cooling fan is essentially a 115 volt ac, three phase electric motor with a fan installed on the shaft of the rotor assembly. The unit consists of a housing assembly in two sections, a rotor assembly, an end-bell assembly, and a fan (see Figure 5). The outer section of the housing forms a duct through which cooling air flows to the ram air ducts. It is separated from the inner section by vanes. The inner section supports the rotor assembly and the fan which is mounted on the forward end of the rotor shaft. The end-bell assembly is attached to the aft end of the inner housing section and supports the aft end of the rotor shaft as well as the cone. An arrester is located in the opening at the apex of the cone.





Ram Air Diverter Valve -- Description
Figure 4

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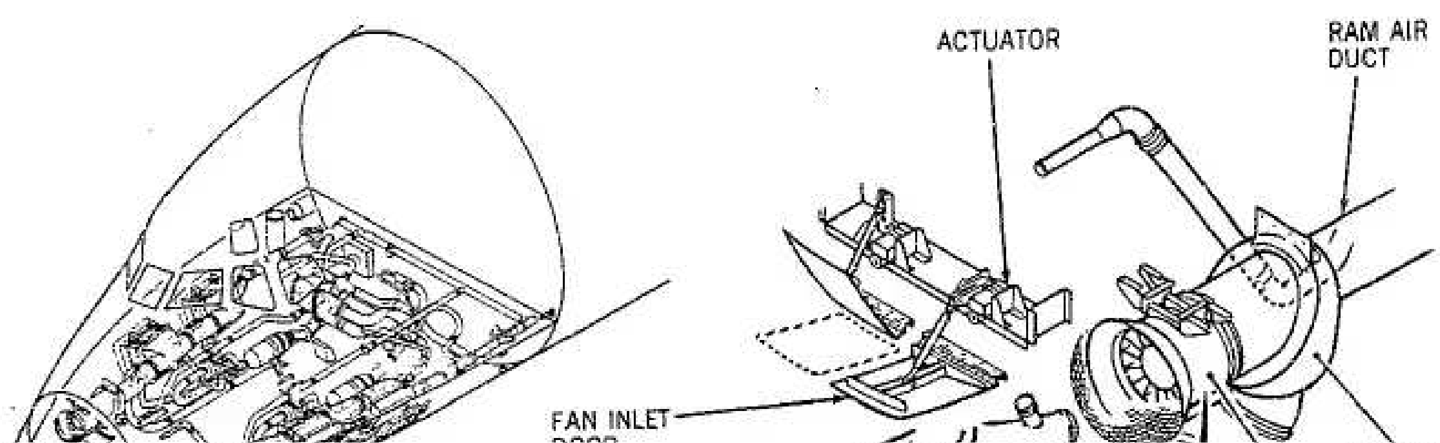
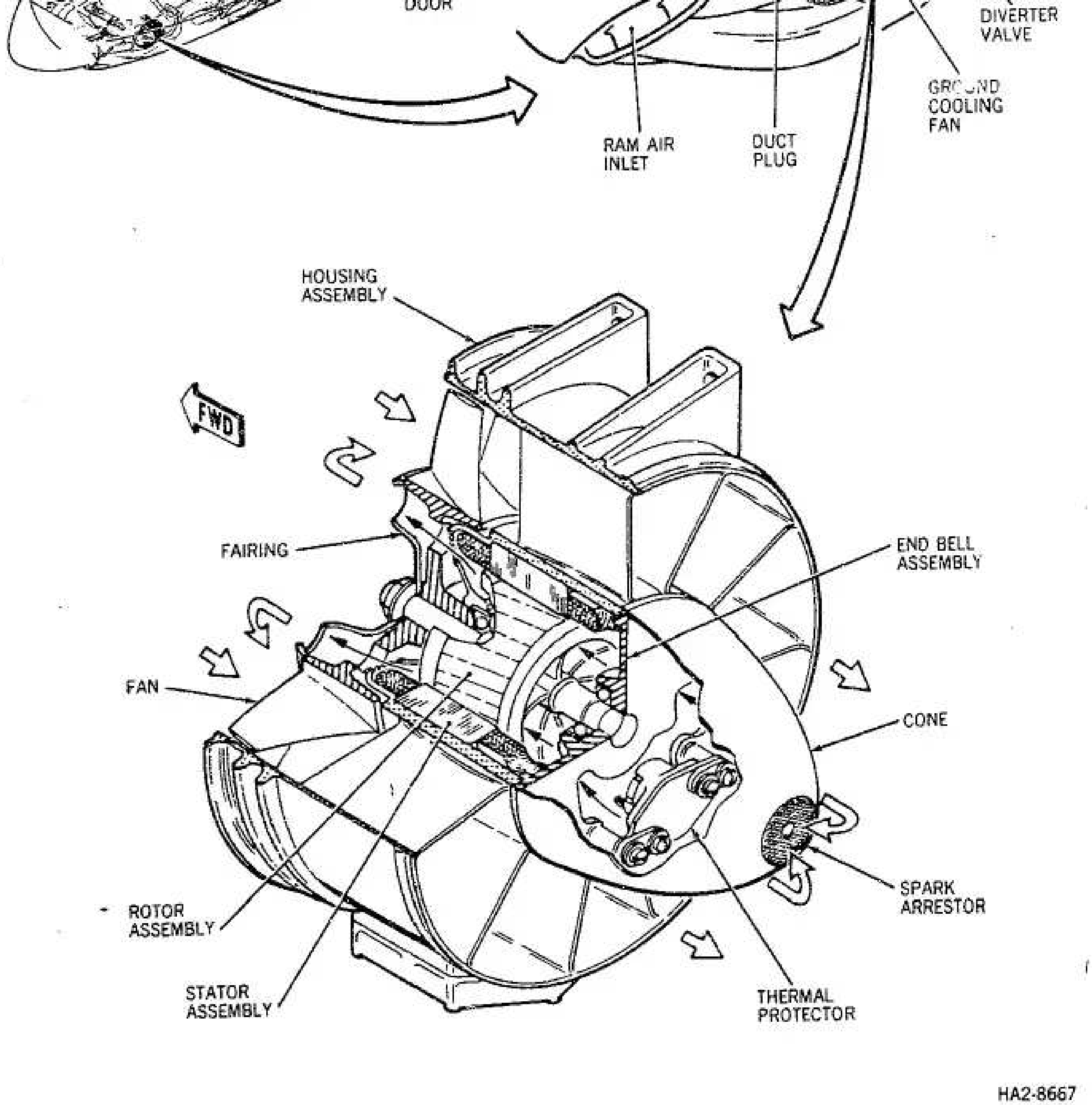




Pack Cooling Fan
Figure 5

(3) Air blown through the ram air ducts by the ground cooling fan also cools the fan motor. When the fan starts air flows between the inner and outer sections of the housing and into the ram air ducts. As a result pressure at the arrester is higher than pressure in front of the rotor fairing assembly. Part of the fan air then passes forward through the arrester, circulates around the motor for cooling and exhausts forward through holes in the front of the inner housing section, fan web, and fairing. The holes in the housing are screened to act as an arrestor at the forward end.

G. Fan Air Inlet Door

R WARNING: DO NOT USE FAN INLET DOOR FOR ACCESS TO AIRPLANE. DO NOT USE LIP

R OF FAN INLET DOOR OPENING FOR BODILY SUPPORT OR LEVERAGE WHILE
R WORKING IN THIS AREA OF AIRPLANE. WHEN REFRIGERATION PACK
R SHUTDOWN OCCURS, DOORS CLOSE WITHIN 15 TO 20 SECONDS AND COULD
R CAUSE DEATH OR INJURY TO PERSONNEL.

(1) A fan inlet door is provided to allow entrance of ambient air to the ram air system during ground cooling fan operation. A door is provided for each ram air system. The door is rod connected to a motor-operated actuator and opens inward automatically when air conditioning is on if the airplane is on the ground.

H. Fan Air Inlet Door Actuator

R WARNING: DO NOT USE FAN INLET DOOR FOR ACCESS TO AIRPLANE. DO NOT USE LIP
R OF FAN INLET DOOR OPENING FOR BODILY SUPPORT OR LEVERAGE WHILE
R WORKING IN THIS AREA OF AIRPLANE. WHEN REFRIGERATION PACK
R SHUTDOWN OCCURS, DOORS CLOSE WITHIN 15 TO 20 SECONDS AND COULD
R CAUSE DEATH OR INJURY TO PERSONNEL.

(1) The fan air inlet door actuator opens the inlet door during ground cooling fan operation and closes it during flight. The actuator motor is 115 volt ac, single-phase, and is reversible. An actuator is installed aft of the fan air inlet doors.

(2) The fan inlet door actuator moves the fan air inlet door open any time the ground cooling fan is operating and closes the door when the fan goes off. At full open or closed a limit switch in the actuator shuts off the motor. When the circuit to the motor is open its magnetic friction brake prevents the door position changing. There is an actuator for each fan air inlet door.

3. Operation

A. General

(1) Ram air system operation discusses two independently operational systems. Each system although operating independently utilizes air flowing through the ram air ducts and affects air conditioning operation. The systems discussed are pack cooling and ram air exhaust control (see Figure 6).

B. Pack Cooling

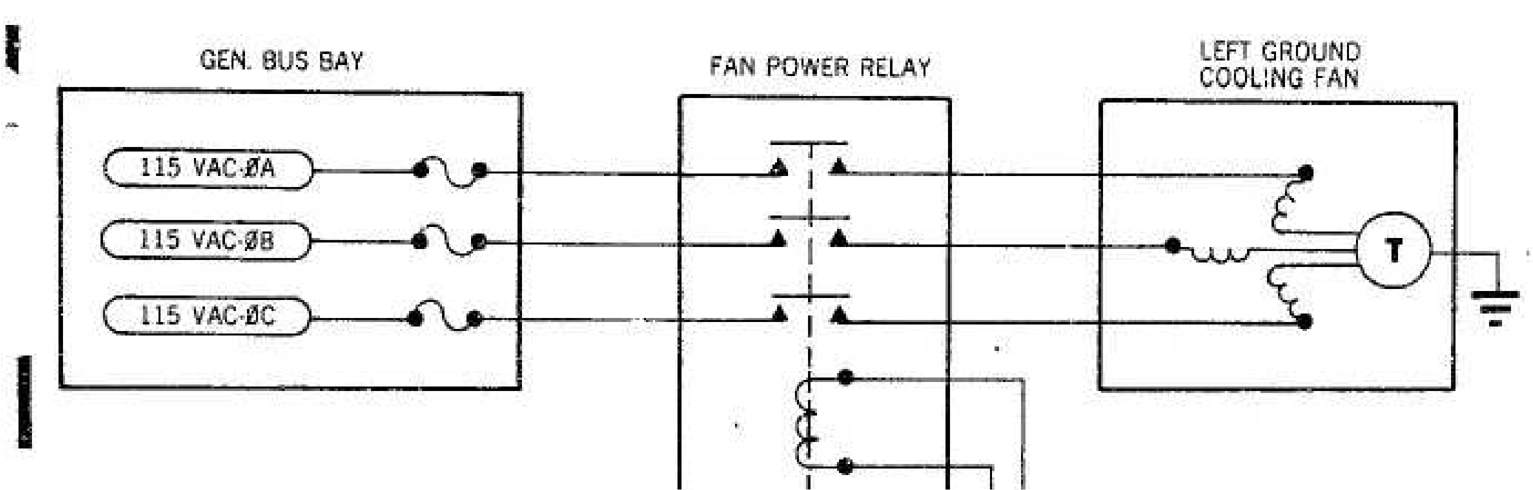
R WARNING: DO NOT USE FAN INLET DOOR FOR ACCESS TO AIRPLANE. DO NOT USE LIP
R OF FAN INLET DOOR OPENING FOR BODILY SUPPORT OR LEVERAGE WHILE
R WORKING IN THIS AREA OF AIRPLANE. WHEN REFRIGERATION PACK
R SHUTDOWN OCCURS, DOORS CLOSE WITHIN 15 TO 20 SECONDS AND COULD
R CAUSE DEATH OR INJURY TO PERSONNEL.

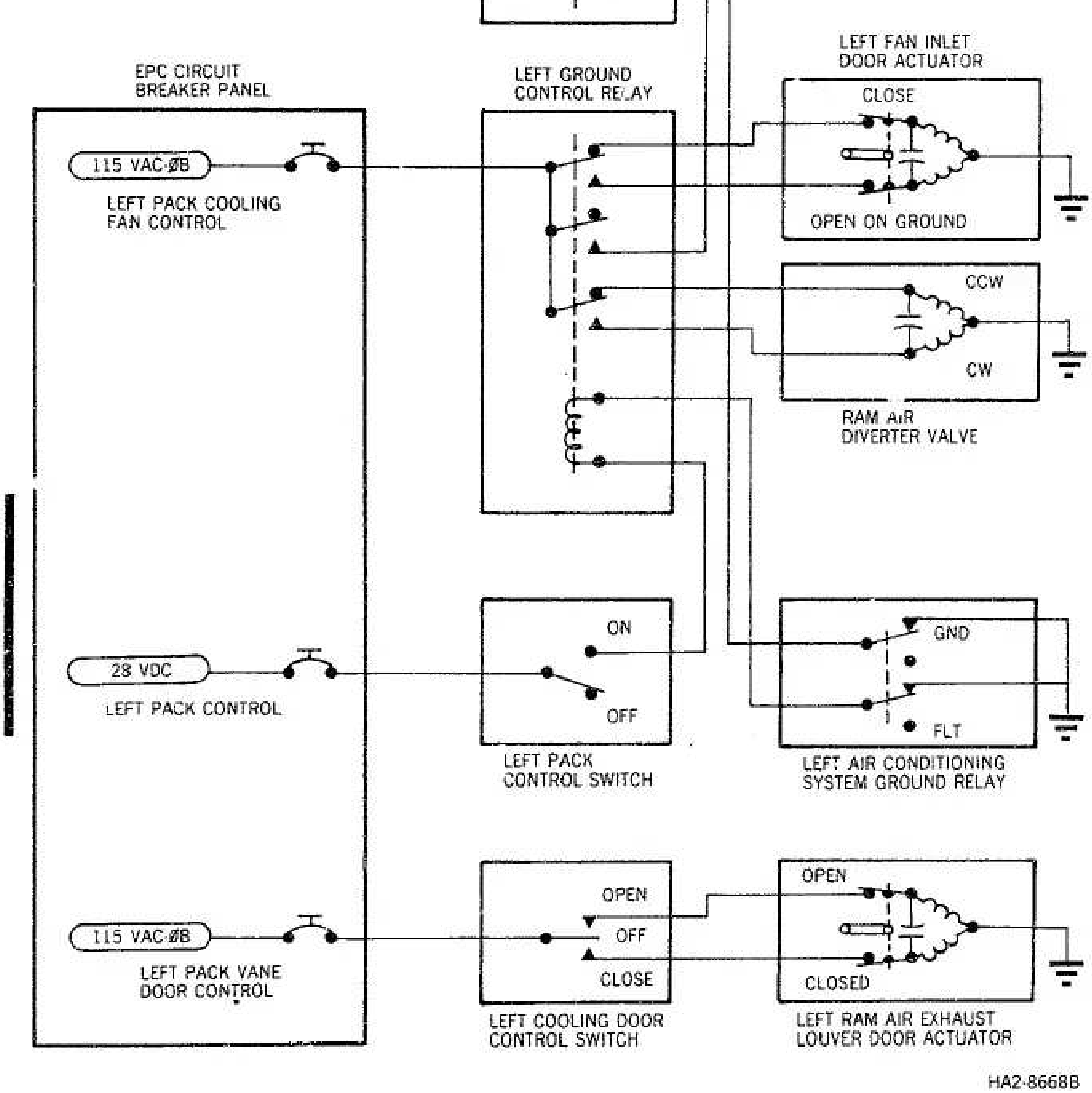
(1) The pack cooling system normally operates automatically when air conditioning pack switches are on and the airplane is on the ground. A 28 volt dc control circuit energizes a cooling fan relay to complete a three phase, 115 volt ac circuit to the ground cooling fan, direct another 115 volt ac circuit to open the fan air inlet door and closes

the ram air diverter valve. Cooling air passes through the ram air ducts, the primary and secondary heat exchangers, and exhausts from the primary and secondary heat exchanger ram air exhaust louver doors. After takeoff the ground control relay opens and the cooling fan relay becomes deenergized. The ground cooling fan stops and the fan air inlet door drives closed. The ram air diverter valve is positioned to ram and ram air passes through the heat exchangers and out the exhaust louver doors. On landing, the reverse sequence applies and the ground cooling fan provides the cooling air for the packs.

C. Ram Air Exhaust Control

(1) Ram air exhaust control is provided to cut down ram airflow when not needed. A three position switch, momentary open, momentary close, and off is provided to position ram air exhaust louver doors in each pack. When held at open the doors move toward open until the switch is released. On releasing the switch the circuit to the exhaust louver door actuator is opened and the brake in the actuator holds the position obtained. Moving the switch to CLOSED reverses door movement in the same manner. Since ram air exhaust louver doors operate independently of pack cooling and is of benefit only during flight, the exhaust louver doors should be moved to full open during ground air conditioning operation.





Ram Air Circuit Schematic (Typical)
Figure 6

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RAM AIR EXHAUST LOUVER DOOR ACTUATOR - MAINTENANCE PRACTICES

1. General

R A. The ram air exhaust louver door actuator drives the ram air exhaust louver doors.

B. The ram air exhaust louver door actuator has a detachable motor leaving the remainder of the actuator intact.

2. Removal/Installation Ram Air Exhaust Louver Door Actuator

A. Prepare Ram Air Exhaust Louver Door Actuator for Removal

(1) Open applicable pack vane door control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Open the access door located between the exhaust louver doors.

B. Remove Ram Air Exhaust Louver Door Actuator

(1) Disconnect electrical plug from actuator.

(2) Remove bolt connecting exhaust door pushrods to actuator arm. Do not loosen pushrod jamnuts.

(3) Remove four bolts which secure actuator to actuator mounting bracket and remove actuator, actuator arm and clamp as an assembly.

C. Install Ram Air Exhaust Louver Door Actuator

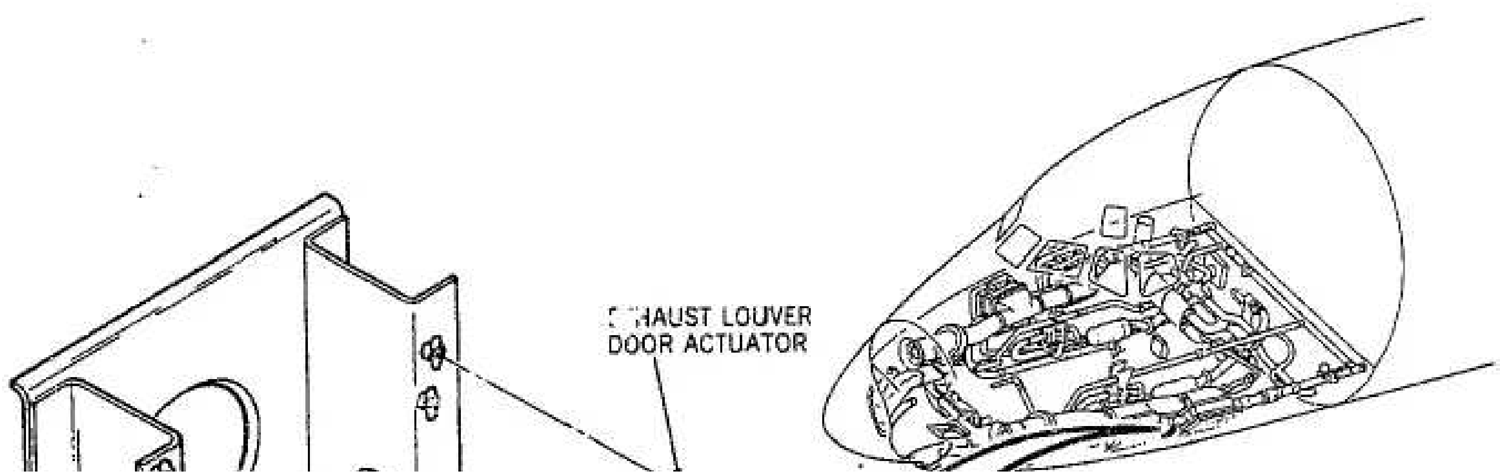
(1) Manually position ram air exhaust louver doors to the full close position.

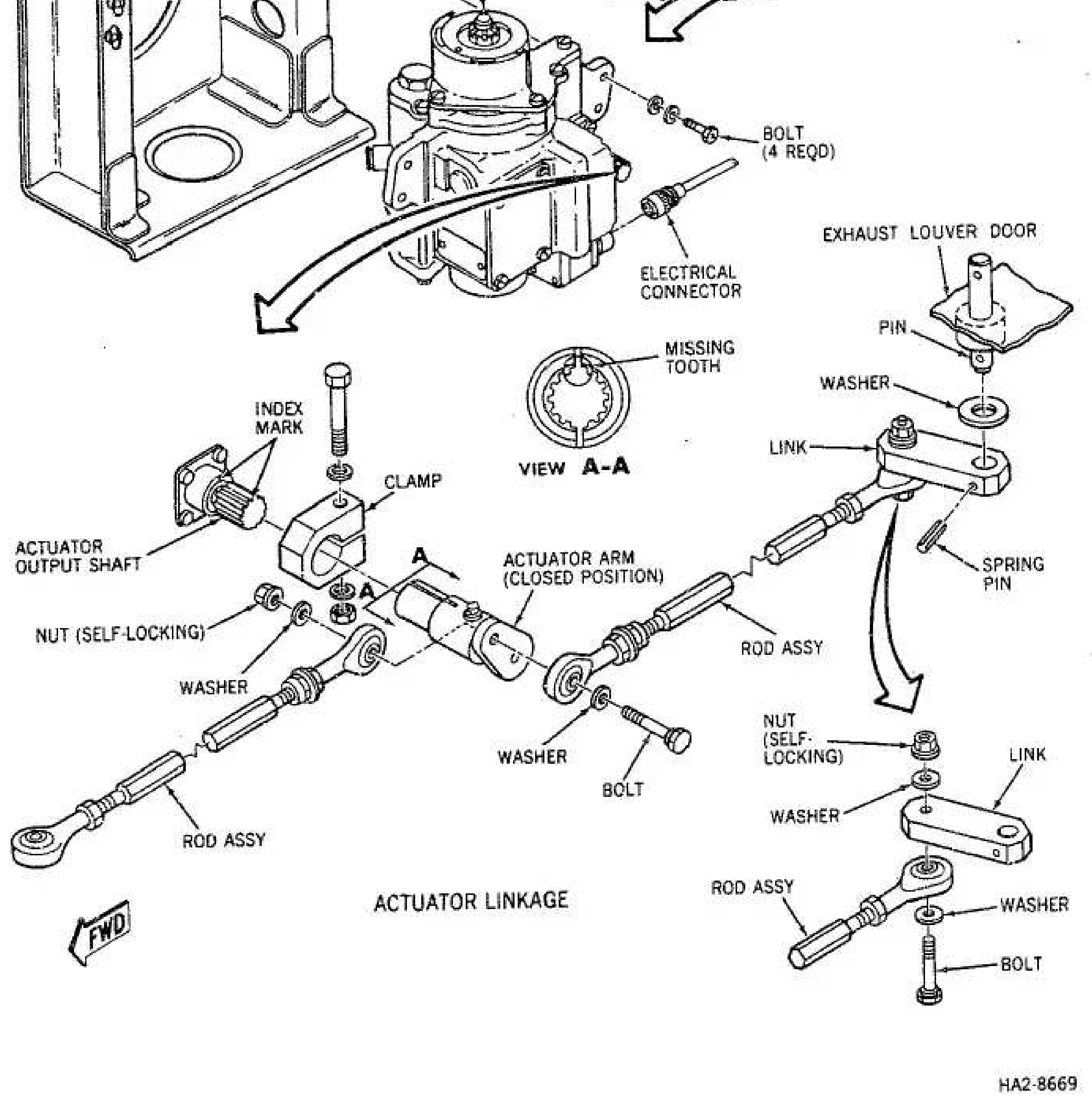
(2) Check that the inboard output shaft of the new actuator is protected by a spline cap and that the cap has been removed from the outboard shaft.

(3) Check that actuator mount surface which mates to the mounting bracket is absolutely clean. Install actuator to mounting bracket with four bolts.

NOTE: Mating surfaces of actuator mount and mounting bracket provide electrical bonding for the actuator.

(4) Check that actuator is in the close position. In close position an index mark on the wide spline of the output shaft will align with an index mark on the actuator. If actuator is in the close position proceed with step 6., if not, move it to the close position per step 5.





Ram Air Exhaust Louver Door Actuator --
Installation
Figure 201

(5) Move ram air exhaust louver door actuator to the close position.

(a) Connect electrical plug to actuator.

(b) Connect external electrical power.

(c) Close applicable pack vane door control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(d) Hold cooling doors switch on systems engineer's control panel to close position until index mark on wide spline of output shaft aligns with index mark on actuator housing.

index mark on actuator housing.

(e) Open applicable pack vane door control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(f) Disconnect electrical plug from actuator.

(6) Install actuator arm and clamp assembly.

(a) With actuator arm and clamp held together as an assembly install actuator arm end with missing tooth on actuator output shaft so wide tooth of actuator output shaft fits in missing tooth of actuator arm.

(b) Tighten bolt on actuator arm clamp.

(c) Install bolt connecting exhaust door pushrods to actuator arm.

(7) Connect electrical plug to ram air exhaust louver door actuator.

(8) Perform ram air exhaust louver door indicating system adjustment (see 21-56-6).

3. Removal/Installation Ram Air Exhaust Louver Door Actuator Motor

A. Remove Ram Air Exhaust Louver Door Actuator.

B. Remove Ram Air Exhaust Louver Door Actuator Motor

(1) Remove wiring cover plate on actuator housing (see Figure 202).

(2) Remove cushion from housing and disconnect actuator motor leads at splices.

(3) Release two motor mounting screws.

(4) Remove motor carefully while holding motor mounting screws in place and add nuts to motor screws or motor end bell and base will separate from motor stator.

C. Install Ram Air Exhaust Louver Door Actuator Motor

(1) Install motor and route motor leads to area of actuator housing where cushion is installed, use care not to let motor end bell and base separate from motor stator.

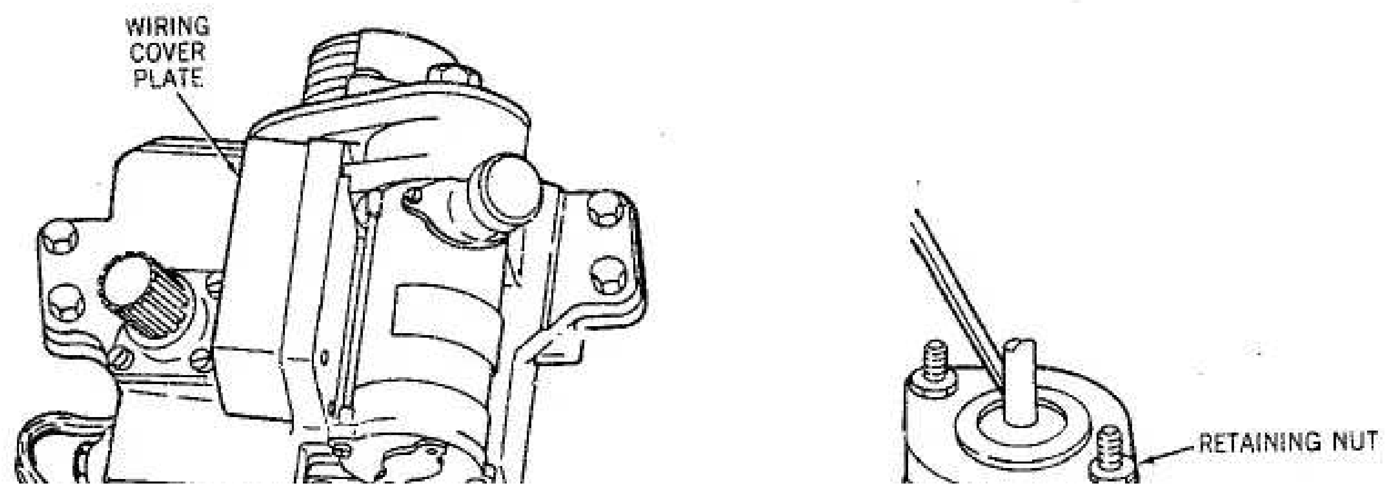
(2) Torque motor attaching screws five to seven pound-inches in two places.

(3) Install and crimp replacement splices on motor leads, and cover with sleeving, in actuator housing.

(4) Attach cushion to housing with adhesive, position wiring between cushion

and housing so that wiring is separated to prevent possible short cir-
cuits, making certain that wiring remains as positioned.

(5) Install wiring cover plate.



HA2-8670

Ram Air Exhaust Louver Door Actuator
Motor -- Installation
Figure 202

TOC

RAM AIR EXHAUST LOUVER DOORS - REMOVAL/INSTALLATION

1. General

   A. Two ram air exhaust doors are provided for each cooling pack, one exhaust door for each primary and secondary heat exchanger. These doors are used to control flow of cooling air through heat exchangers.

   B. Access to exhaust louver doors is from outside the airplane. Removal, installation, and test procedures for left and right assemblies are identical.

identical.

C. Ram air exhaust louver doors for each cooling pack are driven by a single actuator. If new exhaust door is installed, linkage between door and door actuator must be adjusted after installation with doors and actuator in closed position.

2. Removal/Installation Ram Air Exhaust Louver Door (See Figure 401)

A. Remove Ram Air Exhaust Door

(1) Open applicable pack vane door control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Remove ram air exhaust door actuator access panel.

(3) Remove screws attaching fairing panel to airplane. Remove panel.

(4) Disconnect actuator drive rod from exhaust door vane drive shaft.

(5) Support exhaust door and remove screws securing door to airplane. Remove exhaust door.

B. Prepare for Installation of Exhaust Door

(1) Check condition of seal on heat exchanger.

(2) Check that ram air exhaust door actuator is in closed position. If actuator is not in close position.

(a) Connect electric power source to energize airplane circuits.

(b) Place COOLING DOORS switch, on system engineer's control panel, at close. The cooling doors position indicator, on the same panel, will indicate the actuator position.

C. Install Ram Air Exhaust Louver Door

(1) Verify actuator is driven to fully closed position (arm forward).

(2) Make certain applicable vane door control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel, is open.

(3) Position ram air exhaust door to airplane and install screws.

(4) Connect actuator drive rod to exhaust door vane drive shaft.

R (5) Adjust length of actuator drive rod as necessary to obtain required clearance between door louvers shown in Figure 401. Tighten jamnuts on tie rod drive.

R NOTE: Dimension shown is average gap for five louvers of any exhaust door assembly.

(6) Position fairing panel and install screws to attach panel to airplane structure.

(7) Close vane door control circuit breaker and operate ram air doors open and closed. Recheck clearance between closed louvers.

R (7a) Check louver adjustment, gap of 0.38 (±0.06) inch for secondary and
R primary or 0.50 $^{+0.00}_{-0.12}$ inch for primary louver doors is acceptable.

R (7b) Check louver door indicating systems for proper indications
R (see 21-56-6).

(8) Install exhaust louver door actuator access panel.

(9) Turn off air conditioning and remove electrical power if no longer required. Disconnect external power source.

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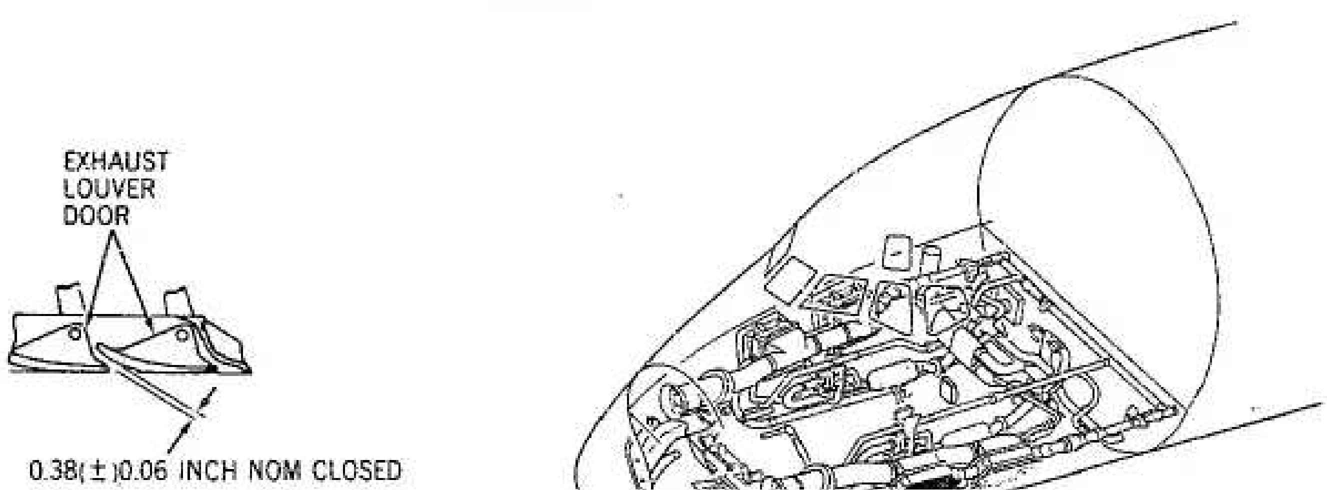

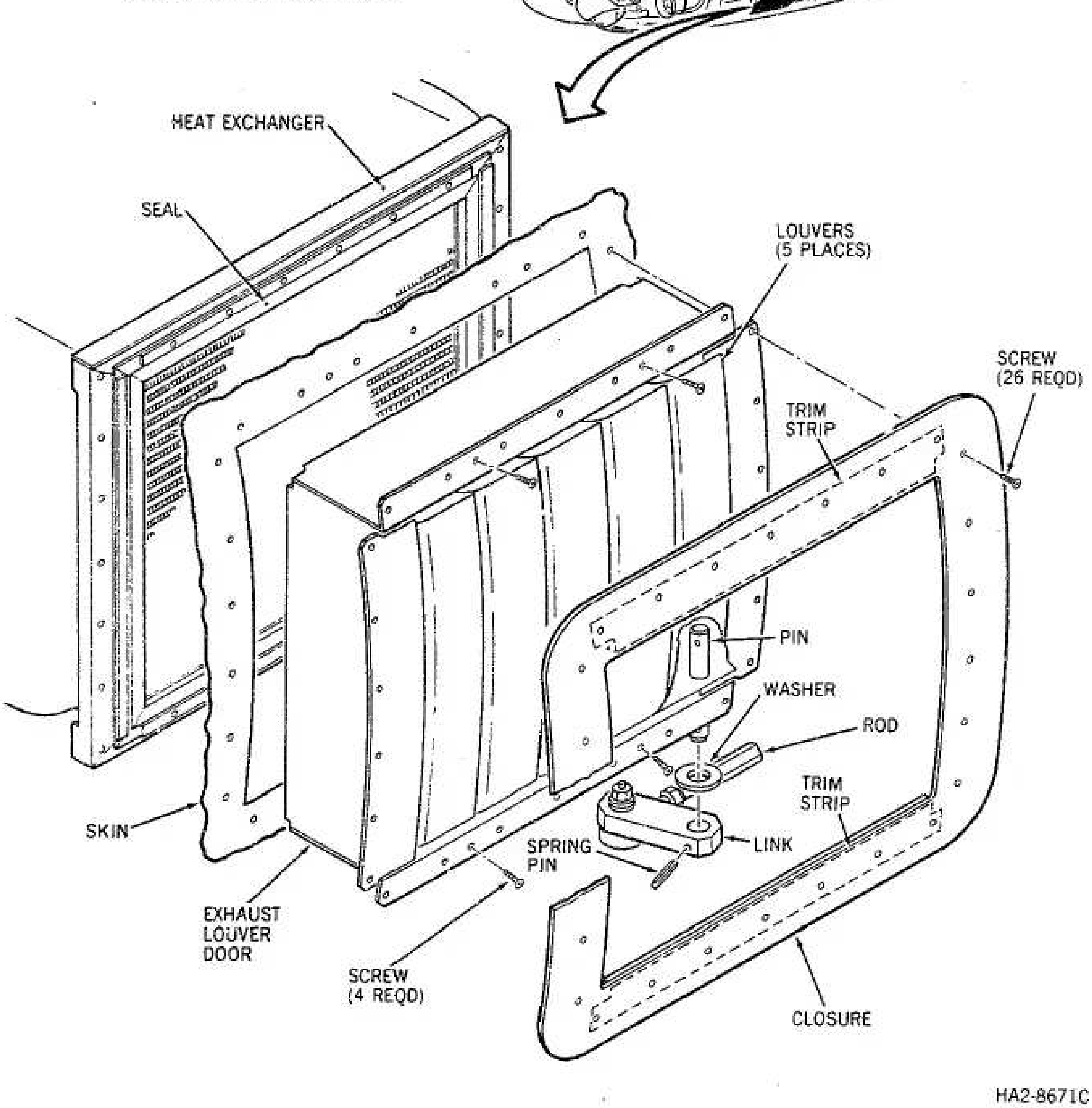

Ram Air Exhaust Louver
Door--Installation
Figure 401

TOC

RAM AIR DIVERTER VALVE - MAINTENANCE PRACTICES

1. General

   A. A ram air diverter valve, installed in each air conditioning system, is located in the compartment forward of the nosewheel well. Each valve has three ports. One port is connected to a ram air duct at the forward end; the second port is connected to the heat exchanger ram air duct at the aft end; and the ground cooling fan is mounted on the third port. The diverter valve actuator may be removed without removing the valve.

B. Access to the ram air diverter valves is through the nosewheel well forward end and/or through the external access panel.

C. Removal, installation, and test procedures for each ram air diverter valve are identical.

2. Tools and Equipment Required

A. Sealant, PR-1422, (Products Research Co.), or equivalent, is used to seal ram-air diverter valve body.

3. Removal/Installation Ram Air Diverter Valve

A. Remove Ram Air Diverter Valve

(1) Open applicable pack cooling fan control circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Disconnect electrical connector from air diverter valve actuator.

(3) Loosen clamp and disconnect air diverter valve from ram-air inlet duct.

(4) Remove valve from ground cooling fan duct.

(5) Remove valve from heat exchanger ram air duct. Replace gasket if damaged.

(6) Disconnect valve support and link and remove valve through nosewheel area access.

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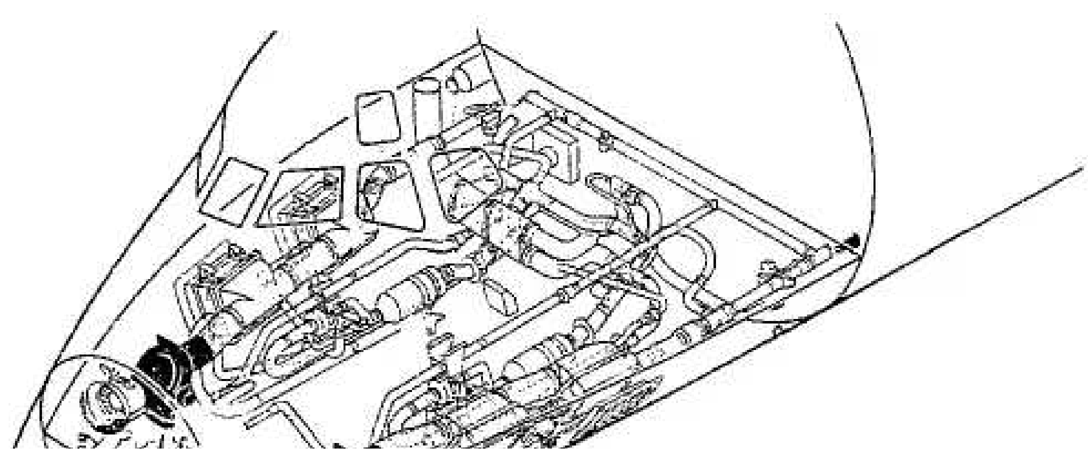

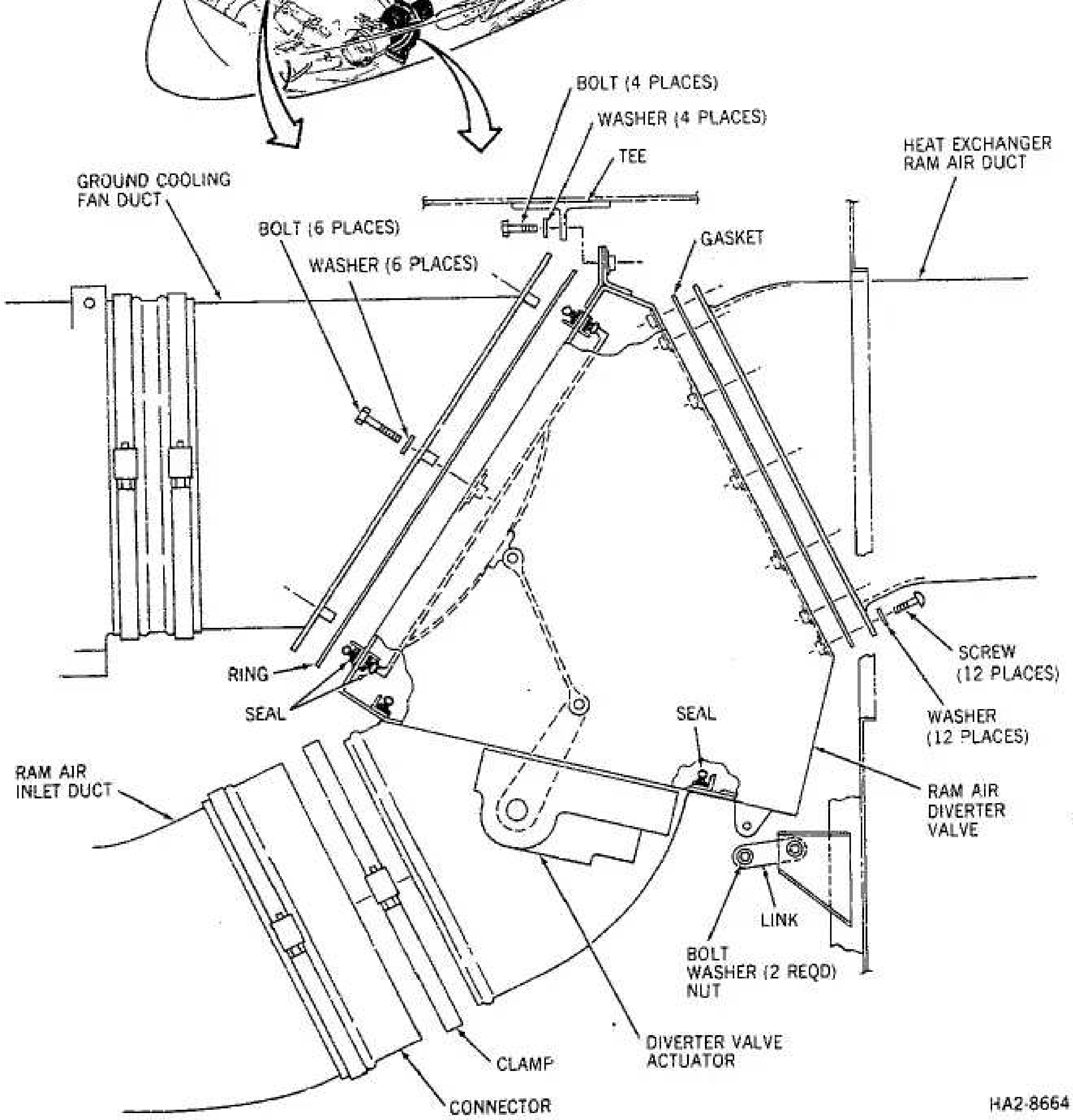

Ram Air Diverter Valve -- Installation
Figure 201

B. Install Ram Air Diverter Valve

(1) Make certain pack cooling fan control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel, is open.

(2) Check condition of pressure sealing around body. If sealant has deteriorated, apply a fillet of sealant (PR-1422) to deteriorated areas.

(3) Install new gasket on valve to heat exchanger ram air duct.

(4) Install valve on support.

(5) Connect valve to heat exchanger duct. Tighten bolts to torque of 20 to 25 inch pounds.

(6) Seal all bolts with sealant.

(7) Connect valve to ram-air duct. Tighten clamps fingertight plus 1/2 turn.

(8) Connect support link to valve. Adjust link so that no strain is imposed on valve.

NOTE: Position the air diverter valve so that the ground cooling fan makes connection with the six studs on the fan duct in such a manner that the seal between the valve and the duct is compressed. The flexible connections at the ram-air inlet duct allow the valve to be positioned to mate with the fan.

(9) Connect electrical connector to actuator.

(10) Close pack cooling fan control circuit breaker.

(11) Check that air diverter valve is in ram air position (valve flapper covering fan port).

NOTE: When the air diverter valve is in the ram-air position (flapper covering the fan air port), the flapper is visible through the ram air inlet. The flapper is not visible in the fan position.

(12) Place applicable pack control switch on. Check that air diverter valve moves to fan position (valve flapper covering ram air port).

(13) Place pack control switch to off. Check that air diverter valve returns to ram air position (valve flapper covering fan port).

(14) Test ram air system (see 21-56-0, Adjustment/Test).

C. Remove Ram Air Diverter Valve Actuator

(1) Open applicable pack cooling fan control circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Disconnect electrical connector from actuator.

(3) Loosen coupling screw.

(4) Remove actuator from valve support mount.

D. Install Ram Air Diverter Valve Actuator

(1) Make certain pack cooling fan control breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel, is open.

(2) Install ram air diverter valve actuator on support mount.

(3) Align spline of actuator shaft with spline of coupling, and tighten coupling screw.

(4) Connect electrical connector.

(5) Close pack cooling fan control circuit breaker.

(6) Check that air selector valve is in ram air position (flapper covering the fan port).

NOTE: When the air selector valve is in the ram-air position (flapper covering the fan air port), the flapper is not visible through the ram air inlet. The flapper is visible in the fan position.

(7) Place applicable pack control switch to on. Check that air diverter valve moves to ram-air position (flapper covering the fan air port).

(8) Place applicable pack control switch to off. Check that air diverter valve returns to ram-air position (flapper covering the fan port).

(9) Install access door.

FAN AIR INLET DOOR ACTUATOR - REMOVAL/INSTALLATION

1. General

A. A fan air inlet door actuator opens a door to provide ambient air for each air conditioning cooling pack during ground operation.

B. Two air inlet door actuators are installed in the nose equipment compartment immediately aft of the radome, and are accessible through the nosewheel well forward access doors.

R **WARNING:** DO NOT USE FAN INLET DOOR FOR ACCESS TO AIRPLANE. DO NOT USE LIP
R OF FAN INLET DOOR OPENING FOR BODILY SUPPORT OR LEVERAGE WHILE
R WORKING IN THIS AREA OF AIRPLANE. WHEN REFRIGERATION PACK
R SHUTDOWN OCCURS, DOORS CLOSE WITHIN 15 TO 20 SECONDS AND COULD
R CAUSE DEATH OR INJURY TO PERSONNEL.

C. The following procedure is for both actuators.

2. Removal/Installation Fan Air Inlet Door Actuator (See Figure 401)

A. Remove Fan Air Inlet Door Actuator

(1) Open applicable pack cooling fan control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Disconnect electrical connector and bonding jumper from actuator motor.

(3) Remove bolts from mounting bracket and remove bracket and actuator.

(4) Remove three actuator mounting bolts and remove actuator.

B. Install Fan Air Inlet Door Actuator

(1) Drive actuator to closed position if necessary, by motoring actuator counterclockwise (viewing shaft end).

NOTE: To motor output shaft in counterclockwise direction connect 115-volt, 400-Hz single-phase ac current to pins B and F of motor receptacle.

(2) Make certain applicable pack cooling fan control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel, is open.

(3) Install inlet door actuator in mounting bracket.

(4) Insert motor output shaft in actuator arm.

NOTE: Align indexing punch mark on actuator output shaft to punch mark on actuator arm.

(5) Install bracket mounting bolts.

(6) Check that door is faired within ±0.050 inches of skin contour.

(7) If necessary, adjust connecting rod until door is faired within ±0.050 inch of skin contour.

(8) Connect electrical connector and bonding jumper to actuator motor.

(8) Connect electrical connector and bonding jumper to actuator motor.

(9) Close applicable pack cooling fan control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(10) Provide electrical power.

(11) Move applicable pack switch to on and check air inlet door is full open.

(12) Move pack switch to off and check that door is faired within ± 0.050 inches of skin contour.

(13) Remove electrical power if no longer required.

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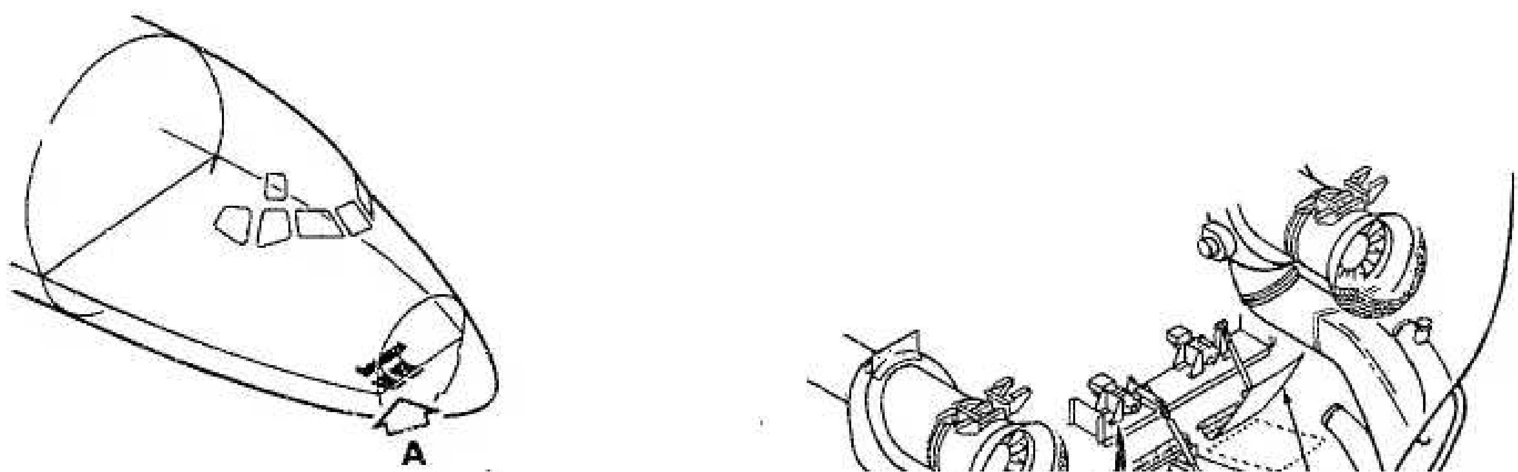

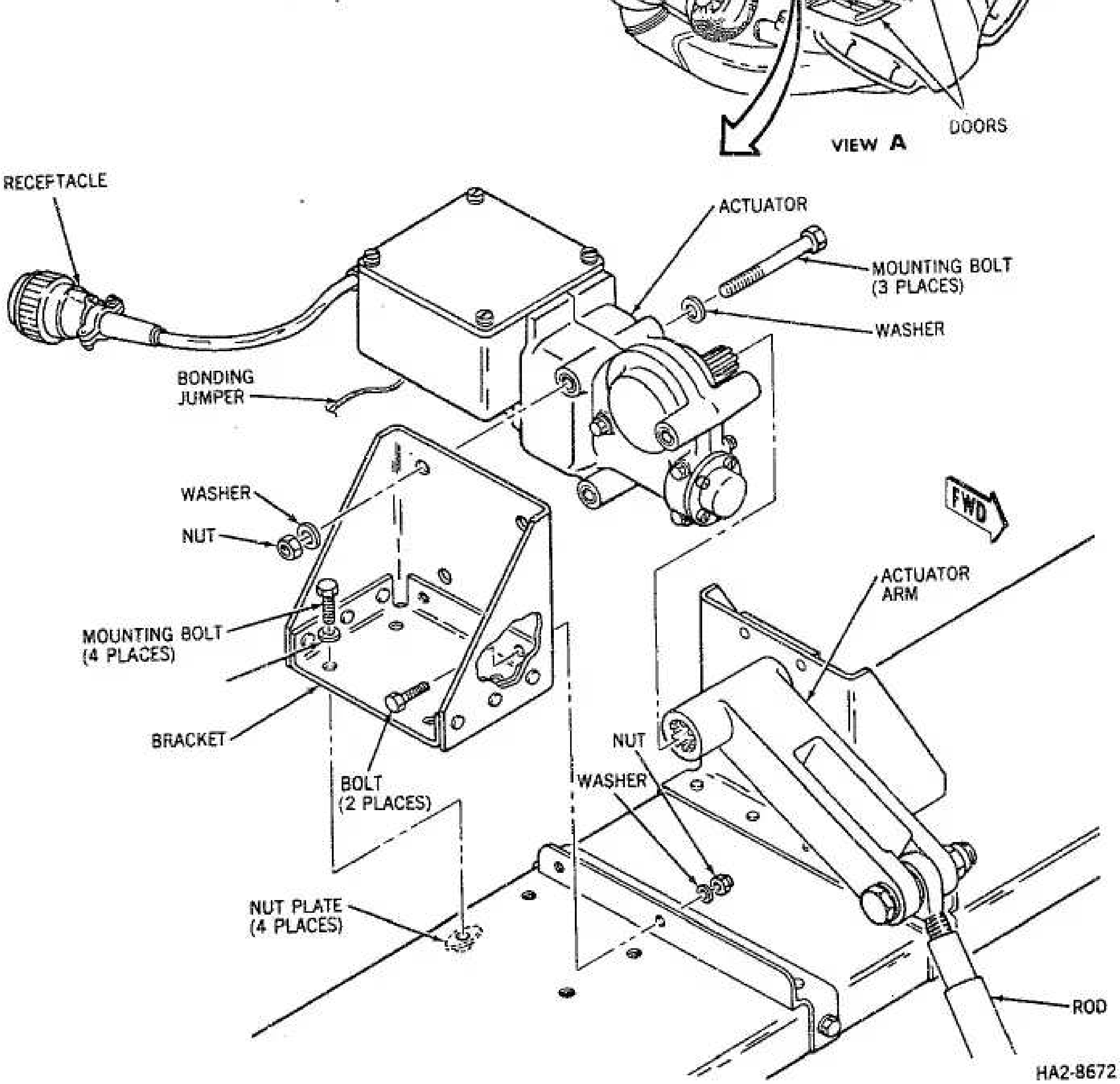

Fan Air Inlet Door Actuator -- Installation
Figure 401

GROUND COOLING FAN - REMOVAL/INSTALLATION

1. General

A. A ground cooling fan supplies cooling air for the heat exchangers during ground operation. Two cooling fans are installed in the nose equipment compartment immediately aft of the radome, and are accessible through the nosewheel well forward acce s doors.

R WARNING: DO NOT USE FAN INLET DOOR FOR ACCESS TO AIRPLANE. DO NOT USE LIP
R OF FAN INLET DOOR OPENING FOR BODILY SUPPORT OR LEVERAGE WHILE

R WORKING IN THIS AREA OF AIRPLANE. WHEN REFRIGERATION PACK
R SHUTDOWN OCCURS, DOORS CLOSE WITHIN 15 TO 20 SECONDS AND COULD
R CAUSE DEATH OR INJURY TO PERSONNEL.

B. The following procedure is for both with any difference noted in the applicable step.

2. Equipment and Materials

A. Ohmmeter

3. Removal/Installation Ground Cooling Fan (See Figure 401)

A. Remove Ground Cooling Fan

(1) Open applicable pack cooling fan control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Remove clamp joining fan housing to bellmouth and screen assembly. Remove bellmouth and screen assembly.

(3) Remove fan terminal box cover and disconnect wires from terminals. (Mark wires for proper installation).

(4) Remove clamp from around end of flexible duct and end of fan housing.

(5) Support fan and remove four bolts connecting mounting bracket to fan body support webs. Remove fan from airplane.

(6) Disconnect bonding jumper from fan.

B. Install Ground Cooling Fan

(1) Make certain applicable pack cooling fan control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel, is open.

(2) Spot clean bonding jumper connection point with a stainless steel wire brush or with an abrasive disk. Connect bonding jumper to fan housing.

CAUTION: DO NOT CLEAN WITH CARBON STEEL BRUSH. EMBEDDED CARBON STEEL PARTICLES MAY CAUSE SERIOUS CORROSION.

(3) Lift fan into position and install bolts through mounting bracket and fan body webs. Connect bonding jumper to bracket.

(4) Check bonding resistance. Resistance between fan housing, adjacent to connecting point, and airplane structure shall not exceed 0.025 ohm.

NOTE: Resistance measurements should be made from bare metal to bare

NOTE: Resistance measurements should be made from bare metal to bare metal.

(5) Remove fan terminal box cover and connect power leads to terminals as marked in 3.A.(3).

(6) Tighten clamp around flexible duct and outlet end of fan housing.

(7) Install bellmouth and screen assembly with V-clamp to inlet end of fan housing.

(8) Close applicable pack cooling fan control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(9) Provide electrical power.

(10) Move applicable pack switch to on and check that fan operates.

(11) Move pack switch to off.

(12) Install fan terminal box cover.

(13) Remove electrical power if no longer required.

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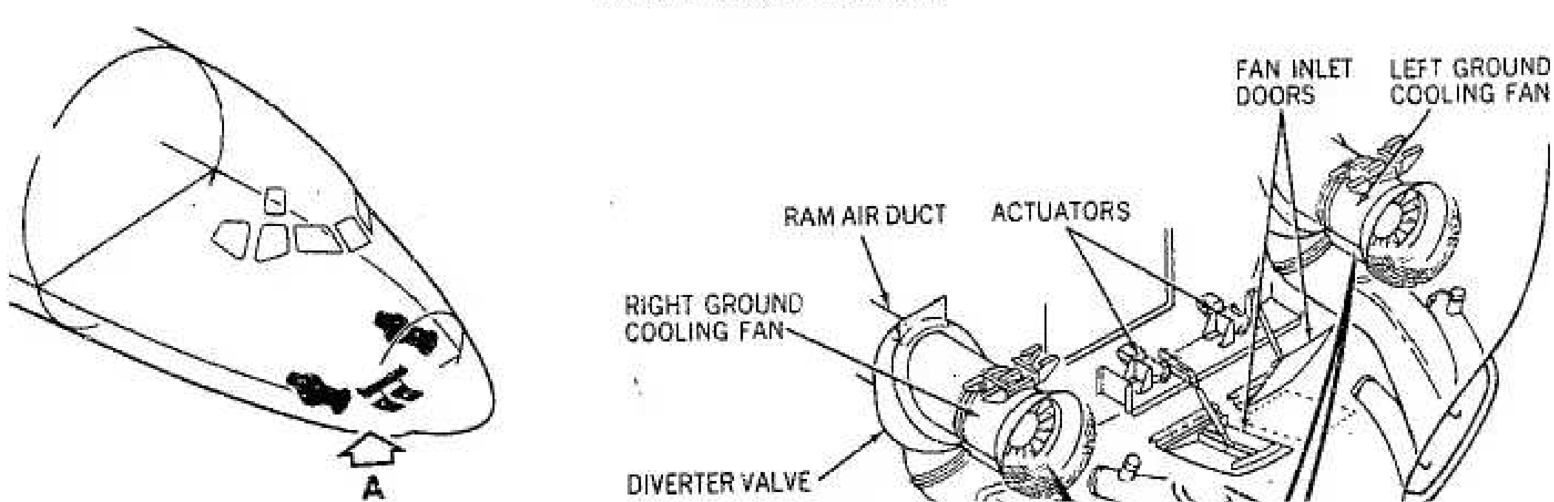

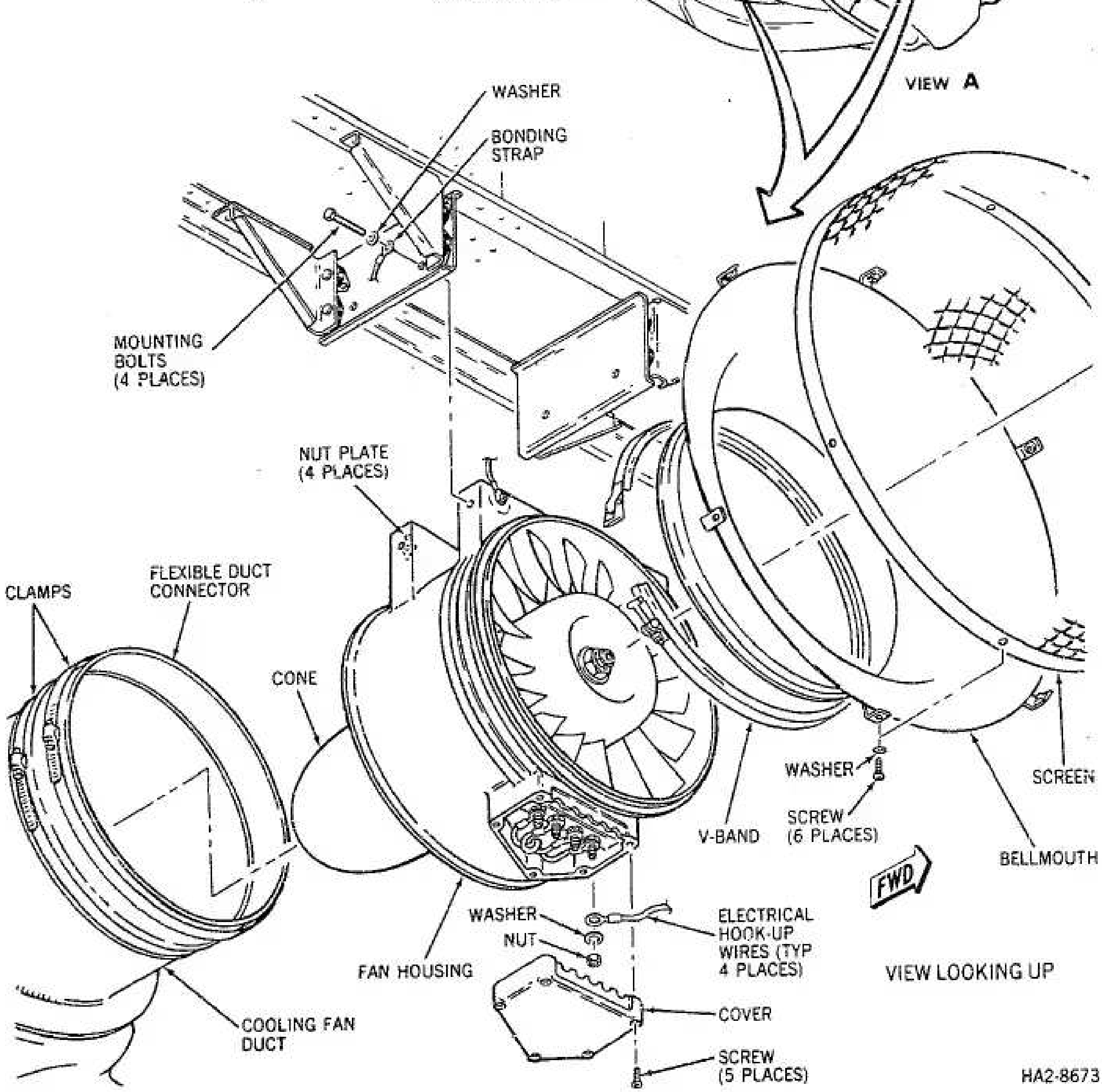

Ground Cooling Fan -- Installation
Figure 401

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POSITION INDICATOR CONTROL UNIT - DESCRIPTION AND OPERATION

1. General

   A. The position indicator control unit provides regulated voltage and circuit adjustment for position indicators used in the temperature control system,
R and the ram air system. See Figure 1.

   B. Power to the control unit is from 28 volt dc bus on heat, vent, and ice protection circuit breaker panel.

C. Regulated current then passes from the control unit to four different position transmitters. Each transmitter is mechanically linked to a valve such that as the valve moves the resistance of the transmitter in the circuit to the position indicator varies. As the resistance varies, so does current, and a corresponding change is induced in the position indicator. A zener diode prevents power source fluctuation from affecting position indication.

D. From the position transmitter the circuit passes back to the control unit before going to the position indicator. Inside the control unit current passes through an adjustable potentiometer then leaves the unit and goes to the indicator. This potentiometer is provided to allow adjustment of indicator pointer sweep and should need no adjustment unless a circuit component such as an indicator, control unit, or position transmitter is being replaced.

E. The adjustable potentiometers are numbered R6, R8, R10, and R12. R6 and R8 vary the sweep of the indicator for the left and right pack cooling door actuators. R10 and R12 provide adjustment for indicator pointer sweep of
R cockpit and cabin mix valves.

F. The position indicator control unit is mounted to a standoff on the back of system's engineer's air conditioning control panel.

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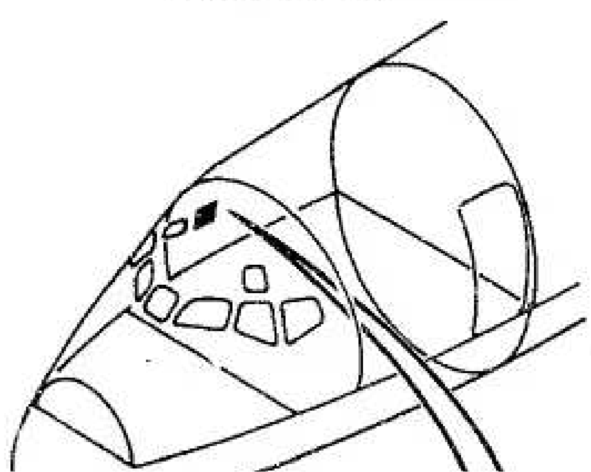
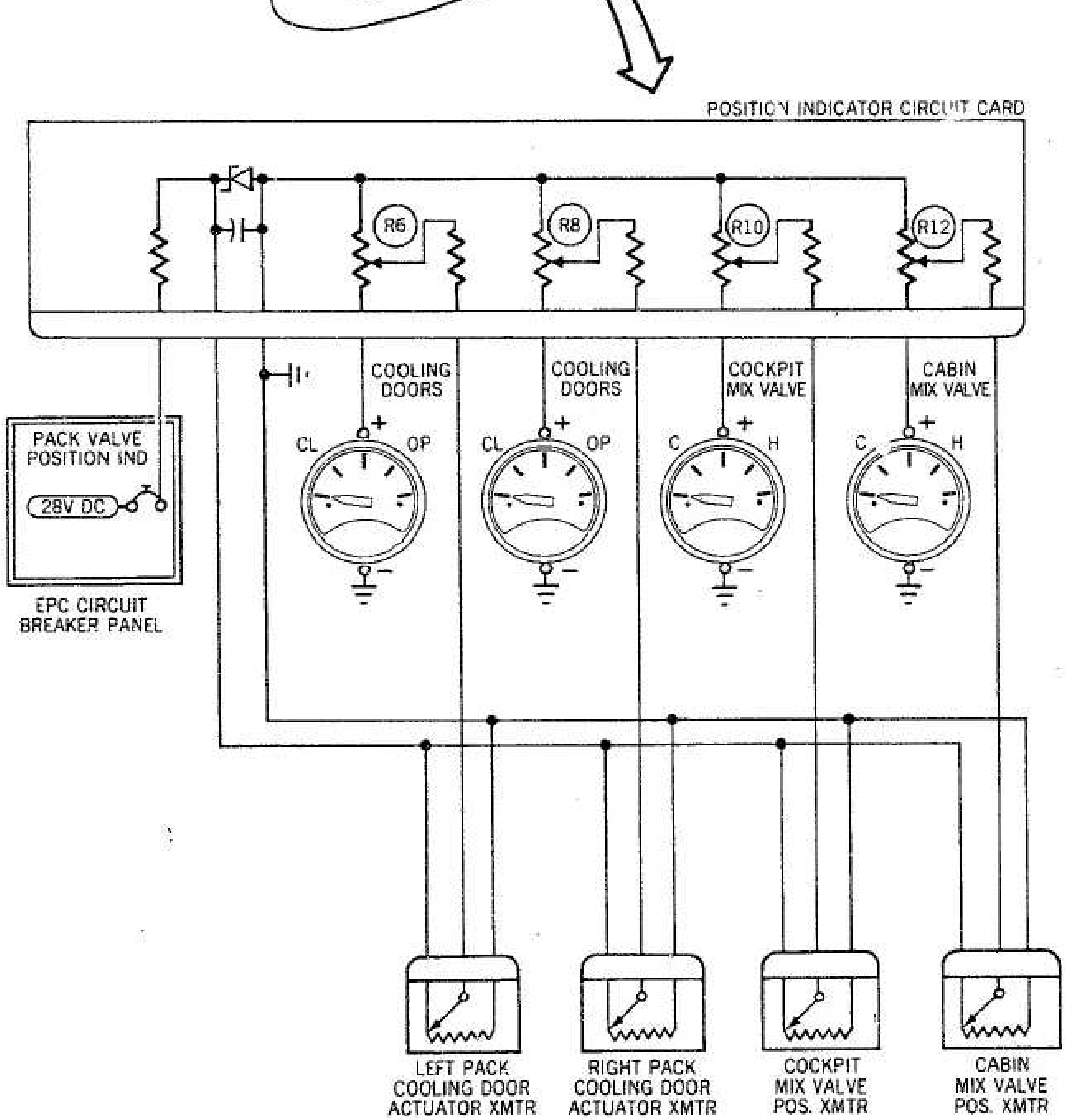
DOUGLAS AIRCRAFT CO., INC.

DC-8 SEVENTY SERIES

MAINTENANCE MANUAL





HA2-8674B

Position Indicator Control Schematic
Figure 1

POSITION INDICATOR CONTROL UNIT - ADJUSTMENT/TEST

1. General

A. The position indicator control unit is the key link between position indicators and valve position transmitters. Whether a valve, indicator, or a control unit is being replaced, a check should be made to determine that valve position and indicator reading are the same.

B. There are four variable resistance potentiometers to be adjusted during

R maintenance. (see Figure 501.) The adjustable potentiometers are numbers R6, R8, R10 and R12. R6 and R8 vary the sweep of the indicator for the left and right ram air exhaust louver door actuators. R10 and R12 provide
R adjustment for indicator pointer sweep of cockpit and cabin mix valves.

C. Two adjustment procedures are provided: Ram Air Exhaust Louver Doors Indicating System Adjustment and Mix Valves Indicating System Adjustment. No attempt should be made to adjust the ram air exhaust louver door actuator position potentiometer. If a problem occurs which cannot be corrected with the ram air exhaust louver doors indicating system adjustment, the exhaust louver door actuator must be replaced.

2. Equipment and Materials

A. Jeweler's screwdriver or equivalent small, very thin-bladed screwdriver.

3. Ram Air Exhaust Louver Doors indicating System Adjustment

A. General

(1) The only adjustment possible in the ram air exhaust louver doors indicating system is the position indicator full scale sweep adjustment. Should this adjustment fail to correct the problem, the applicable actuator must be replaced. The following procedure is applicable to either left or right ram air exhaust louver system.

B. Prepare to Adjust Ram Air Exhaust Louver Doors Indicating System

(1) Provide electrical power.

(2) Make certain pack valve position indicators circuit breaker, located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker panel, is closed.

(3) Make certain applicable pack vane door control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel, is closed.

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(4) Release fasteners holding the air conditioning module to the systems engineer's control panel assembly and lower module for access to circuit card.

NOTE: Support module to prevent load on wiring harnesses.

C. Adjust Ram Air Exhaust Louver Doors Indicating System

(1) Drive ram air exhaust louver doors to full open position by holding applicable cooling door switch to open.

(2) Check that COOLING DOORS position indicator needle coincides with bold

(2) Check that COOLING DOORS position indicator needle coincides with bold mark at OPEN end of scale.

(3) If needle does not coincide with OPEN bold mark, adjust trim screw R6 (left system) or R8 (right system) of control unit until needle and bold mark align.

(4) Drive ram air exhaust louver doors to full closed position by holding applicable cooling door switch to close.

(5) Check that indicator needle is within on the close bold mark.

4. Mix Valves Indicating System Adjustment

A. General

(1) The mix valves indicating system adjustment procedure describes the complete adjustment necessary when a valve and its position transmitter is being replaced. When only an indicator or control unit is replaced it should be unnecessary to adjust valve position transmitters. Their accuracy may be verified by moving the valves to their extremities of travel and checking the indicator. Disregard steps involving moving transmitters when indicators or control unit is replaced until after the sweep adjustment has been made and then only if necessary.

B. Prepare to Adjust Mix Valves Indicating System

(1) Access to the mix valves is through the air-conditioning accessory compartment lower fuselage access doors.

(2) Provide electrical power.

(3) Make certain pack valve position indicators circuit breaker, located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker panel, is closed.

(4) Make certain applicable cockpit manual temperature control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel, is closed.

C. Adjust Mix Valves Indicating System

(1) Move temperature selector to manual cool until indicator needle stops moving then move selector to off.

(2) Check that mix valve is in position as shown in Figure 501.

(3) Check that mix valve position indicator needle coincides with bold mark at cold end of scale.

(4) If needle does not coincide with cold bold mark, loosen three rim clinching clamp screws, rotate transmitter housing relative to its shaft until

R needle does align, then tighten clamp screws.

(5) Move temperature selector to manual warm until indicator needle stops moving then move selector to off.

(6) Check that mix valve position indicator needle coincides with bold mark at hot end of scale.

(a) If needle does not coincide with hot bold mark, note deviation, loosen rim clinching clamp screws (3) and rotate transmitter housing relative to its shaft until one half the deviation is corrected then retighten clamp screws.

(b) If indicator needle does align, no further adjustment is required. Proceed to paragraph 4.C. step (7).

(7) Adjust Position Indicator Control Unit

(a) Move temperature selector to Manual COLD and hold until indicator needle stops moving, then move selector to OFF.

R (b) Release fasteners holding air conditioning module to systems engineer's control panel.

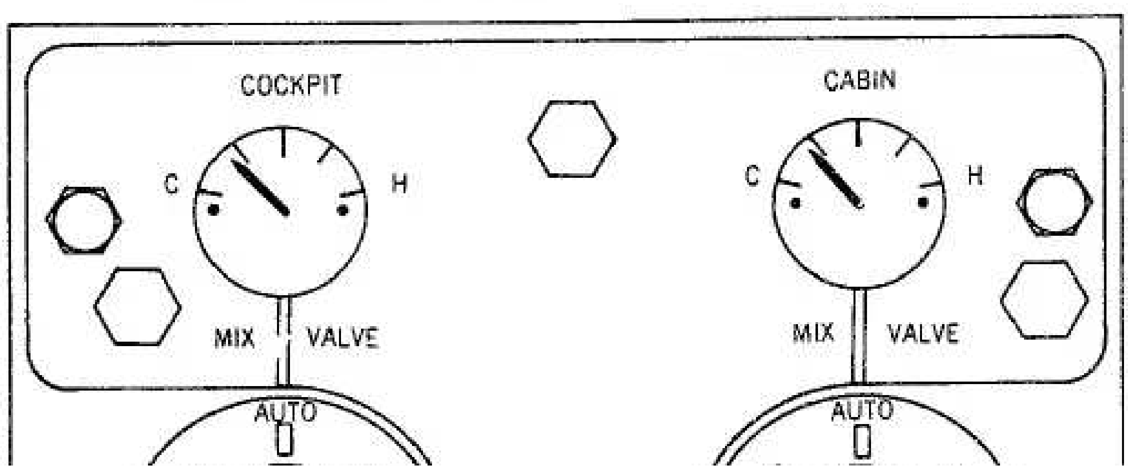
R (c) Lower module for access to control unit.

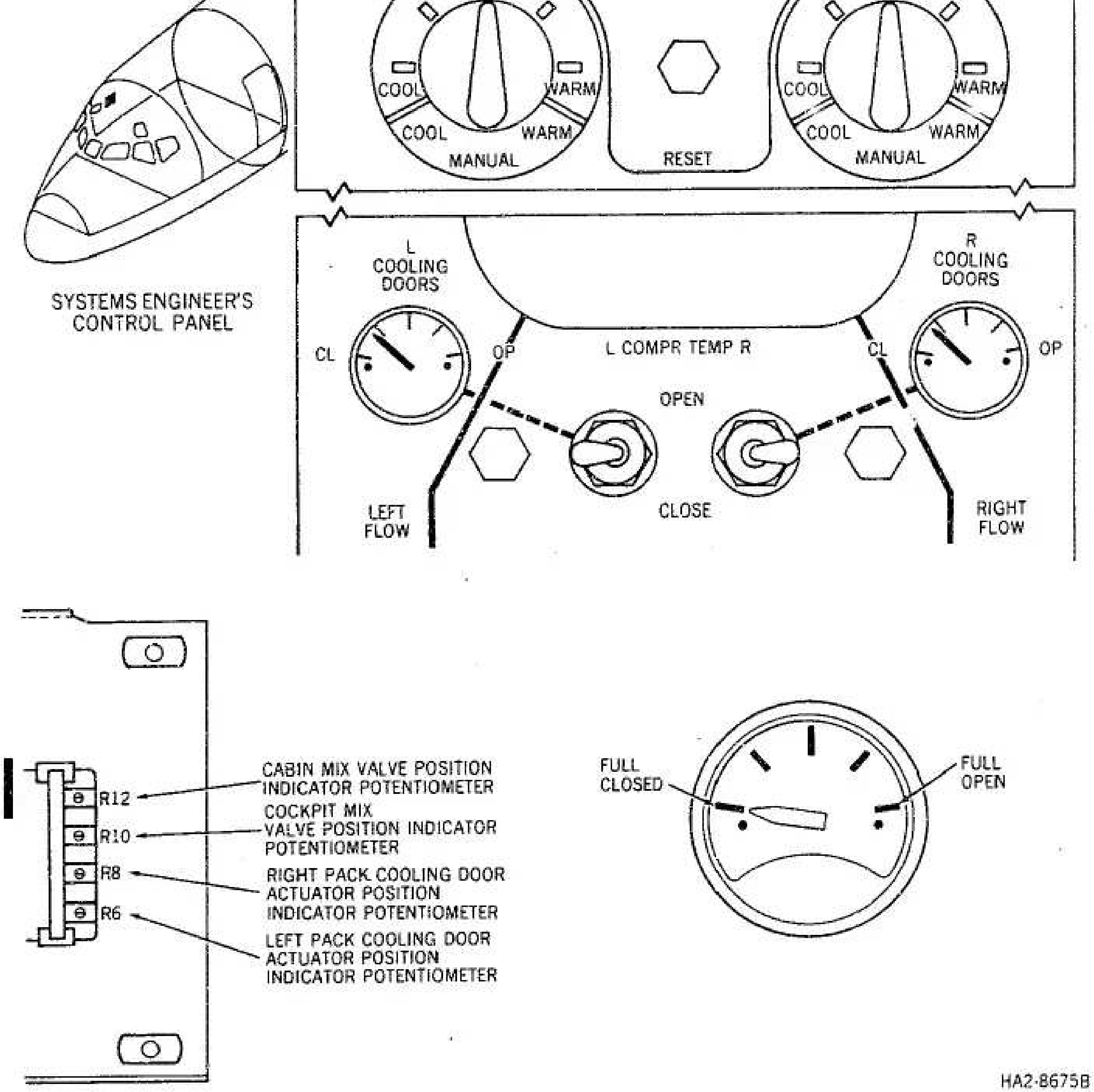
NOTE: Support module to prevent load on wiring harnesses.

R (d) Adjust trim screw, R12 (right - cabin mix valve) or R10 (left -
R cockpit mix valve) until indicator pointer aligns with cold bold mark.

(e) Move temperature selector to manual warm and hold until indicator needle stops moving, then move selector to off. Indicator should read
R correctly. If not, adjustment procedure, paragraph 4.C. step (5)
R through step (7)(d), must be repeated until indicator reads correctly at both extremities of travel.

R (f) Install air conditioning module.





Position Indicating System Equipment
Figure 501

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TEMPERATURE CONTROL - DESCRIPTION AND OPERATION

1. General

A. Conditioned air control covers that portion of the air conditioning system which starts, regulates, and shuts down air conditioning equipment to provide a selected temperature in the flight and passenger compartment. Two sets of controls are provided. One set controls the left mix valve for flight compartment temperature regulation. The other controls the right mix valve and provides for the passenger compartment. Normally each system

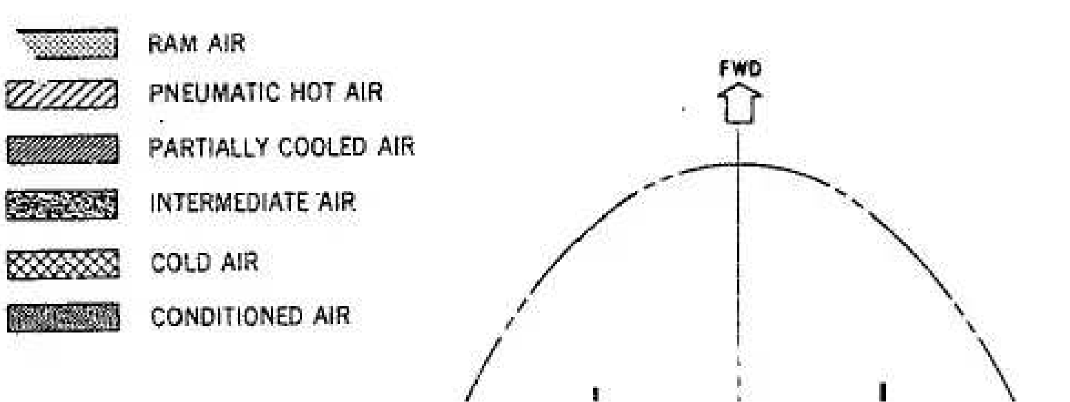
mix valve and provides for the passenger compartment. Normally each system functions automatically according to selections made on the systems engineer's control panel. Should the automatic system malfunction, however, separate manual control systems are provided for raising or lowering flight and passenger compartment temperature.

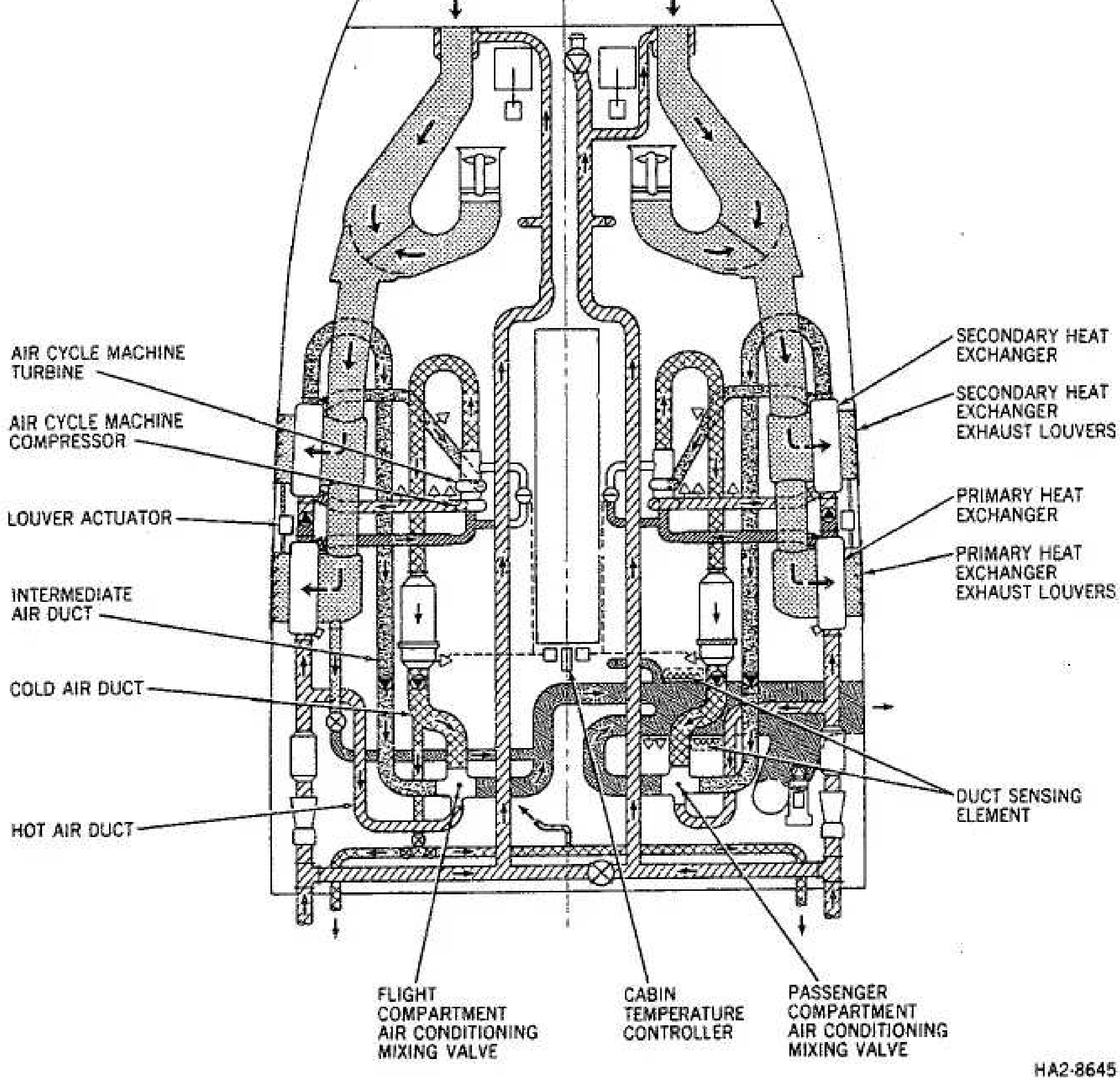
B. Controlling the temperature in the compartments is accomplished by controlling the temperature of air entering the compartments. Air conditioning operation begins when the pack switches are turned on. The switches open the pack flow control and shutoff valves permitting bleed air from the pneumatic system to enter the air conditioning system. Part of this hot air passes straight through to the mix valves and the remainder passes through the cooling packs on its way to the mix valves. The mix valves then mix the air, cooled in the packs, with the hot air from the pneumatic system. The proportion of each is based on compartment temperature selected (see Figure 1).

C. During automatic operation a regulation system continuously monitors compartment temperature, duct temperature, and changes in compartments supply air temperature to keep the compartments at the selected temperature level. During manual operation the mix valve changes position as a result of direct electrical control. The indicating system permits monitoring of compartment temperature, conditioned air supply duct temperature, and mix valve position from the systems engineer's control panel.

D. Each temperature control system includes a pack flow control and shutoff valve, an air mix (temperature control) valve, a 190°F (88°C) duct overheat thermal switch, a 240°F (115.5°C) duct overheat thermal switch, a pack switch, and both manual and automatic temperature regulating circuits (see Figure 2).

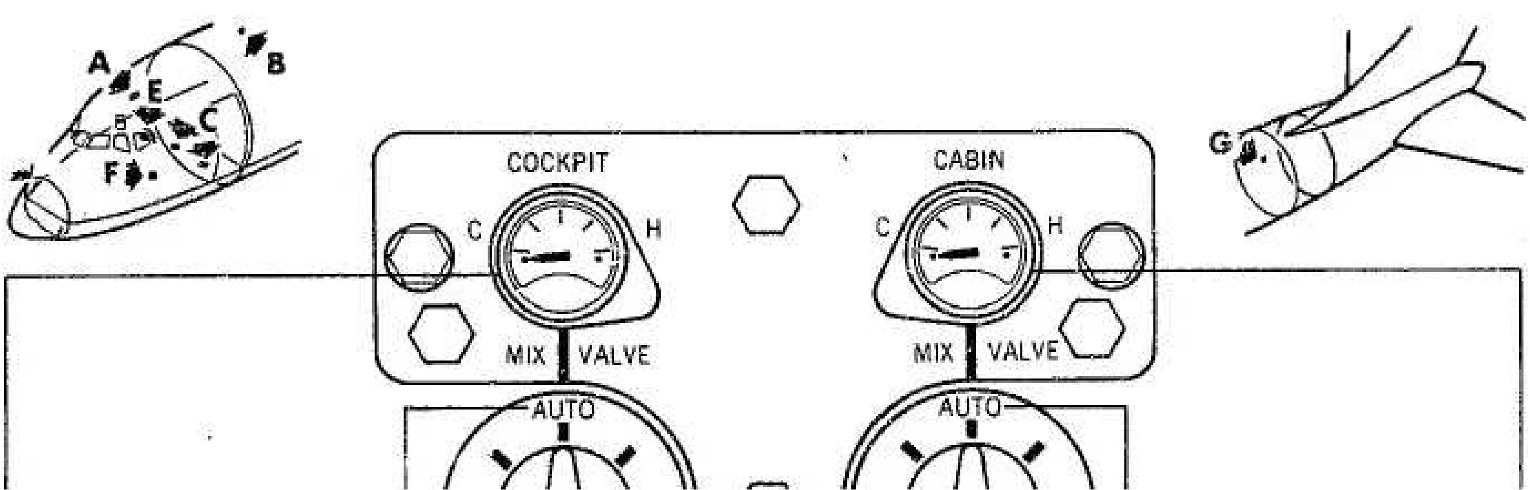
E. A temperature selector is also located on the cabin attendant control panel in the passenger compartment, which is connected in series with the temperature selector for the passenger compartment. The selector at the attendant's control panel allows local control of cabin temperature with ± 2 degrees of the temperature selected on the passenger compartment selector.

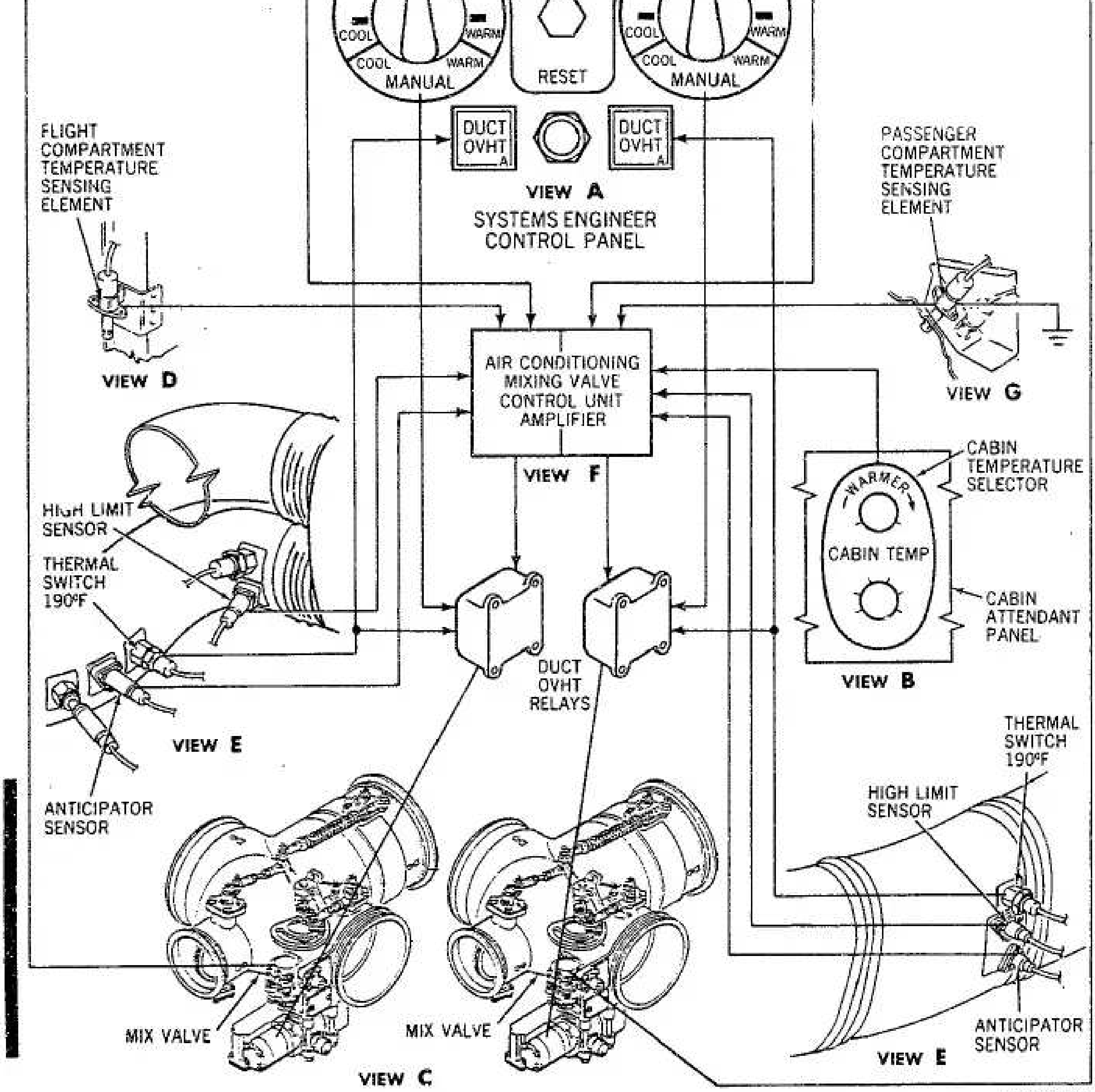




Temperature Control -- Mechanical Schematic
Figure 1

TOC





Temperature Control Components
Figure 2

TOC

F. The manual temperature regulating components consist of two cam-operated switches, in the temperature selector assembly, which are electrically connected to the mix valve actuator. The automatic temperature regulating components include a third cam-operated switch in the temperature selector assembly, a regulator, compartment temperature sensor, anticipator sensor, and a duct temperature limiting sensor.

G. The indicating system inclu‹ᐟcs warning lights for pack trip and duct overheat, a temperature indicator with position selector for pack temperature and supply duct air temperature, mix valve position indicators, and a reset switch.

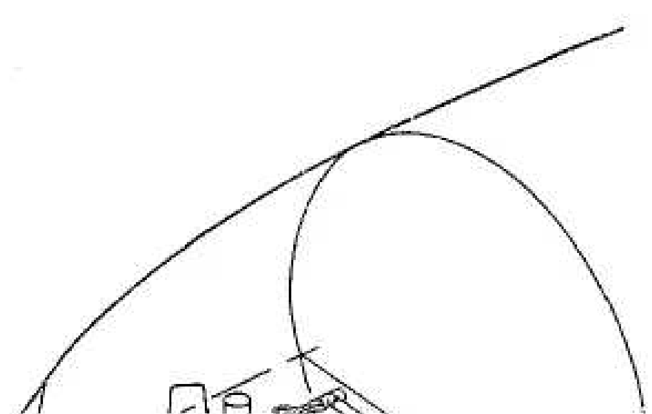
2. Component Description

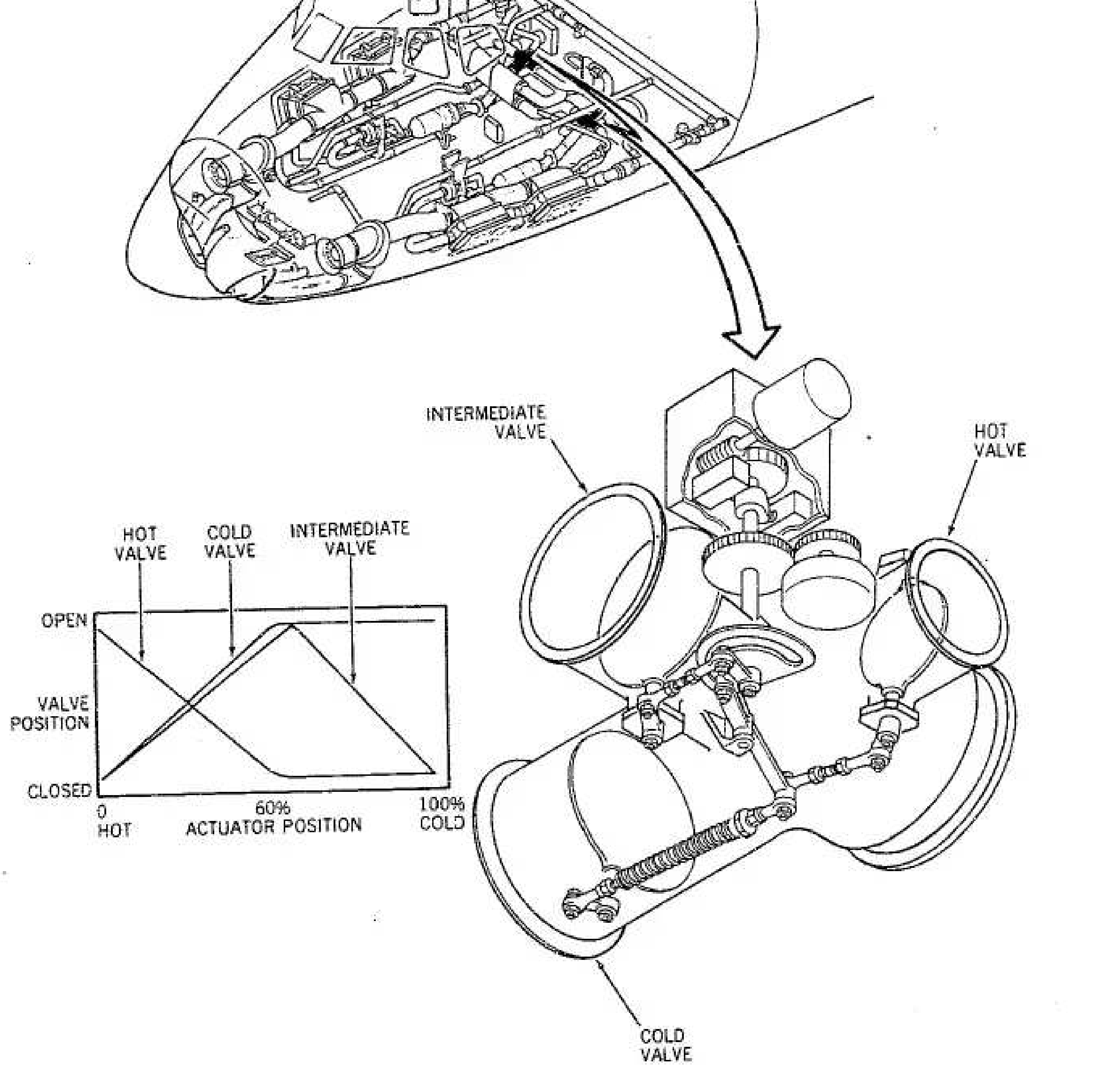
A. Air Conditioning Mixing Valve

(1) The air conditioning mixing valve (see Figure 3), one for each temperature control system, mixes hot, warm, and cold air to maintain the desired temperature for the applicable compartment. Each valve can be electrically operated automatically or manually. Both mixing valves are located in the air conditioning accessory compartment.

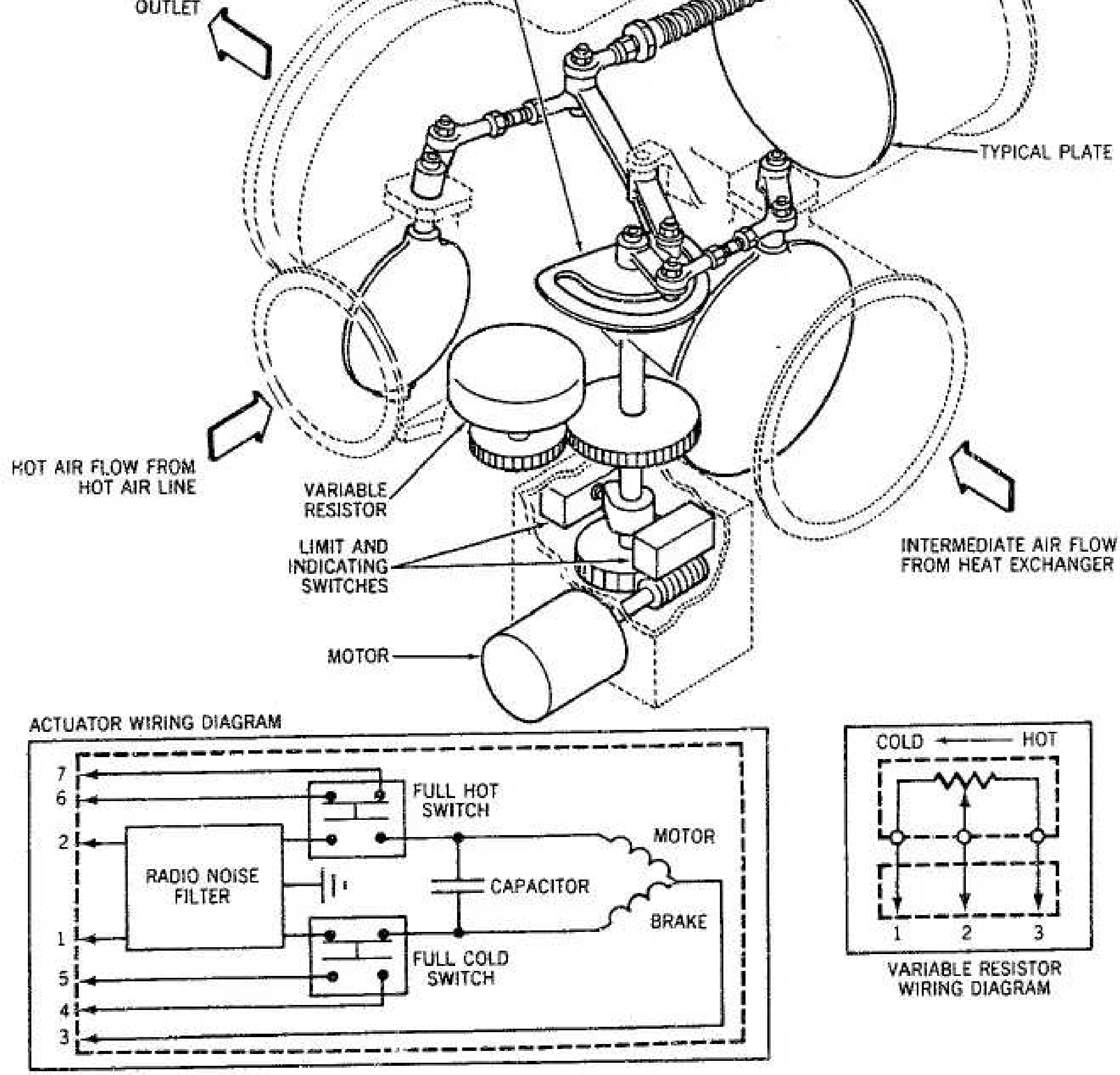
(2) The mix valve is a three-way butterfly, motor-operated valve (see Figure 4). The mix valve is, in effect, a combination of three valves in a single body. A 115-volt ac motor-operated actuator is mechanically connected to the shaft of the intermediate valve. A driv rod, from the actuator to a crank connecting the hot and cold valve, produces movement of all three valves simultaneously. The valves work in opposite directions, so that at approximately 40% of shaft travel from full cold position toward full hot position the intermediate and cold valve are open and the hot valve is closed. The position of the drive rod end with respect to markings on the valve housing permit visual observation of each butterfly position at the valve. A position potentiometer fixed to the upper end of the actuator motor of the intermediate valve shaft is electrically connected to an indicator on the systems engineer's control panel to permit monitoring valve position. Limit switches in the actuator housing interrupt current to the actuator motor at either extremity of travel.

(3) Starting from a full hot air position (see Figure 5), with the cold and intermediate air plates closed and the hot air plate open, the plates are sequenced such that the cold air (water separator) and intermediate air (heat exchanger) plates open as the hot air plate closes. Subsequently, the intermediate air plate again closes as the hot air plate remains closed and the cold air plate remains open to attain a full cold air position. This sequence is reversed when the actuator travels from cold to hot air position.





Air Conditioning Mixing Valve --
External View
Figure 3



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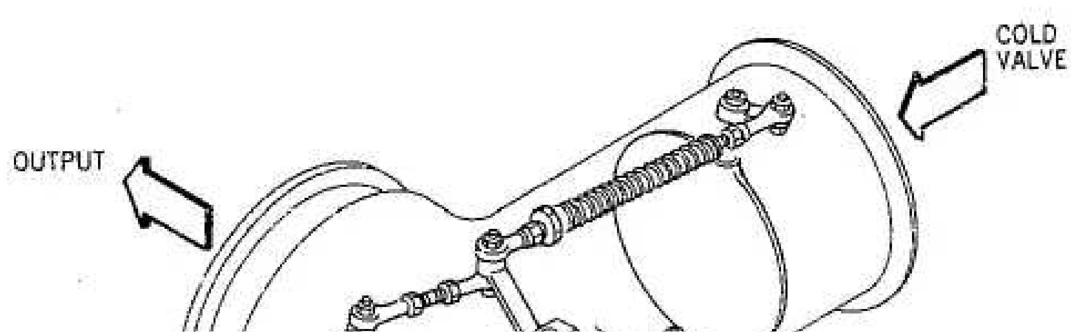
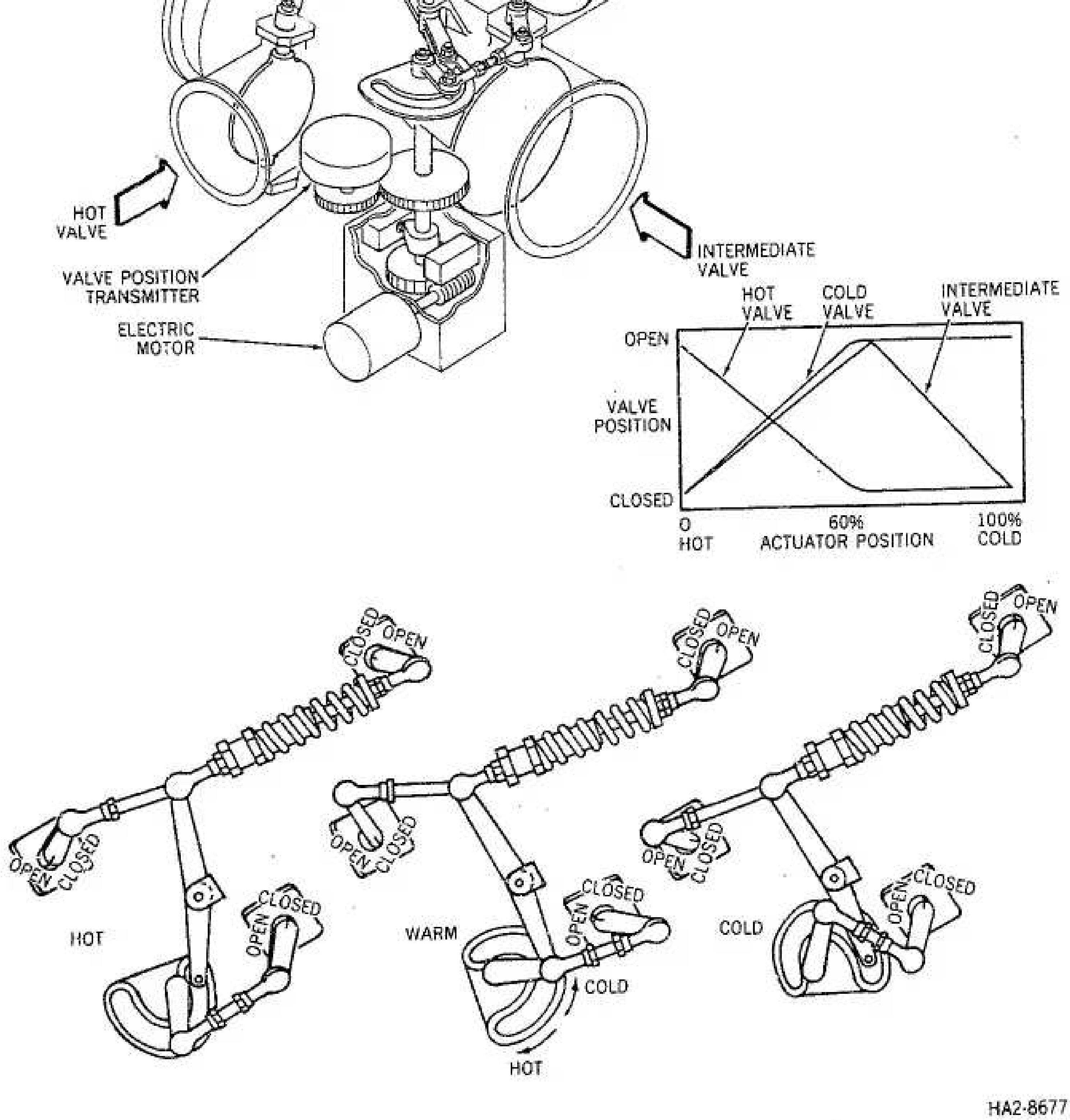
Air Conditioning Mixing Valve -- Schematic
Figure 4





Air Conditioning Mixing Valve -- Operation
Figure 5

TOC

B. Temperature Selectors

(1) The flight and passenger compartment temperature selectors are identical units mounted on the systems engineer's control panel. The face dial is divided into an automatic and manual range. Three switches inside the selector are provided to direct 115 volt ac to the mix valve. Two cams on a cam plate, fixed to the selector knob, close each switch separately as the knob is turned.

(2) In manual, turning the knob clockwise to cool causes one of the cams to

close a switch connected to the mix valve actuator motor, and operate the valve to increase the proportion of cold air passing through the valve. Turning the knob counterclockwise to warm causes the cam to close a switch connected to the mix valve actuator and operate the valve to increase proportion of warm air passing through the valve. When the knob is returned to OFF, both switches are open and the mix valve remains in the position to which it was last driven.

(3) When the temperature selector knob is turned past the manual range into auto, the second cam on the knob shaft closes a switch which directs power to the automatic temperature control circuit. The cam keeps the switch closed throughout the automatic range. In the auto range, the knob also drives a potentiometer which forms one leg of a cabin temperature control bridge circuit.

C. Temperature Regulator

(1) Flight and passenger compartment automatic temperature regulation is obtained from a single unit located in the air conditioning accessory compartment. This unit contains all parts of each regulation system which are not required to be mounted remotely. Separate identical networks are enclosed for each compartment.

(a) The regulators (temperature controllers) utilize a built-in test circuit to provide a quick electrical check of temperature control system components. A rotary test switch, two sets of GO, NO GO lights and a test instruction decal are provided on the face of the controller. The rotary test switch is pressed in each test position.

(2) Each network contains a separate power supply, the fixed resistance legs of three different bridge circuits, a control amplifier, a silicon-controlled rectifier actuator control, and a pulse-forming network.

(3) The three bridge circuits in use for automatic control are: cabin temperature control bridge, temperature control damping bridge, and duct temperature limit bridge.

(4) Each cabin temperature control bridge utilizes two legs which contain variable resistances outside of the regulator. One resistance is located in the temperature selector and is manually set to establish the desired temperature reference. The other is a temperature sensor located in the compartment whose resistance varies according to cabin temperature. The bridge is balanced when compartment temperature causes the temperature sensor resistance to equal the selector resistance.

(5) The temperature control damping bridge also has the variable resistors of two of its legs remotely located. The resistors are contained in a

single anticipator sensor in the distribution system. One resistor is thermally impeded by insulation so that it reacts slowly to temperature change. The other is not insulated, and reacts rapidly to temperature changes. As a result of a sudden temperature change the resistors will not vary at the same rate and the bridge will become unbalanced. The damping bridge slows down system response to prevent delivery of excessively hot or cold air to the cabin. It also assists to prevent overshooting and hunting of the temperature control system when a new temperature is selected.

(6) The duct temperature limit bridge has only one of its resistances remotely located. The duct limit temperature sensor is located such that it senses the temperature of air leaving the mix valve. As the temperature of air leaving the mix valve rises the resistance changes and the bridge becomes unbalanced. If the duct temperature approaches an unsafe level the temperature limit bridge signal will cancel out heat demand signals of the control bridge. A polarizing diode between the duct temperature limit bridge and the magnetic amplifier prevents the temperature limit bridge having any effect on the control bridge signals during a cooling demand.

(7) Each of the three bridge circuits is connected to a magnetic amplifier. The amplifier interprets the signals received, and then signals the silicon-controlled rectifier actuator control to shut off current to the mix valve, complete a circuit to move the valve toward cold, or to complete a circuit to move it toward hot.

D. Thermal Sensing Units

(1) Thermal sensing units in the temperature control system consist of thermal switches, temperature bulbs, and temperature sensors. Thermal switches are used to protect against duct overheat, temperature bulbs are used in conjunction with indicators for monitoring passenger compartment temperature, left and right pack temperatures, and supply duct temperature, and temperature sensors are used with the automatic temperature regulation systems to automatically position the mix valves in obtaining selected temperatures for the flight and passenger compartments.

(2) The thermal switches consist essentially of a bimetal element enclosed in a steel probe. The thermal switch contacts are normally open. At a predetermined temperature the contacts will close. A 190°F duct overheat thermal switch and a 240°F duct overheat thermal switch are used in each control system. The switches are mounted in the main distribution manifold (see Figure 2).

(3) The temperature sensors also utilize variable resistance type elements. As temperature increase their resistance decreases and vice versa. The sensors form a part of the automatic regulation system network to main-

tain selected temperatures in the flight and passenger compartments. A duct limit temperature sensor, anticipator sensor, and cabin temperature sensor are used with each regulation system. The duct limit sensor and anticipator are mounted in the distribution manifold. The flight compartment sensing element is located in the forward face of the footrest provided at the right hand pilot's position. The passenger compartment sensing element is installed on the forward face of the aft drop ceiling.

E. Passenger Compartment Temperature Indicating Components

(1) An indicator and a temperature sensing element are provided to monitor passenger compartment temperatures. The temperature indicator is located on the systems engineer's panel. The temperature indicating sensing element is installed adjacent to the passenger compartment temperature sensing element on the aft drop ceiling panel.

(2) The temperature indicator is a ratiometer operating on the unbalanced bridge principle, and the temperature sensing element is the variable leg of the bridge. Resistance of the element determines the unbalance of the bridge, which causes the indicator needle to be deflected to indicate temperature. The armature of the indicator, with needle attached, has two coils turning in the air gap of a permanent magnet. A galvanometer and the restoring coil are in series with one leg of the bridge and oppose the motion of the deflecting coil. Three hairsprings connect the coils to the bridge circuit.

3. Systems Operation

A. Cabin temperature may be adjusted either by a manual or automatic control system. Both systems utilize 115 volt ac current to adjust the mix valve so that air of the desired temperature is directed into the airplane distribution system. Circuit breakers on EPC circuit breaker panel provide circuit protection for the temperature control system: The pack trip circuit breaker and the overheat circuit breaker during both manual and automatic control operation, the manual temperature control circuit breaker during manual operation, and the auto temperature control circuit breaker during automatic control operation (see Figure 6).

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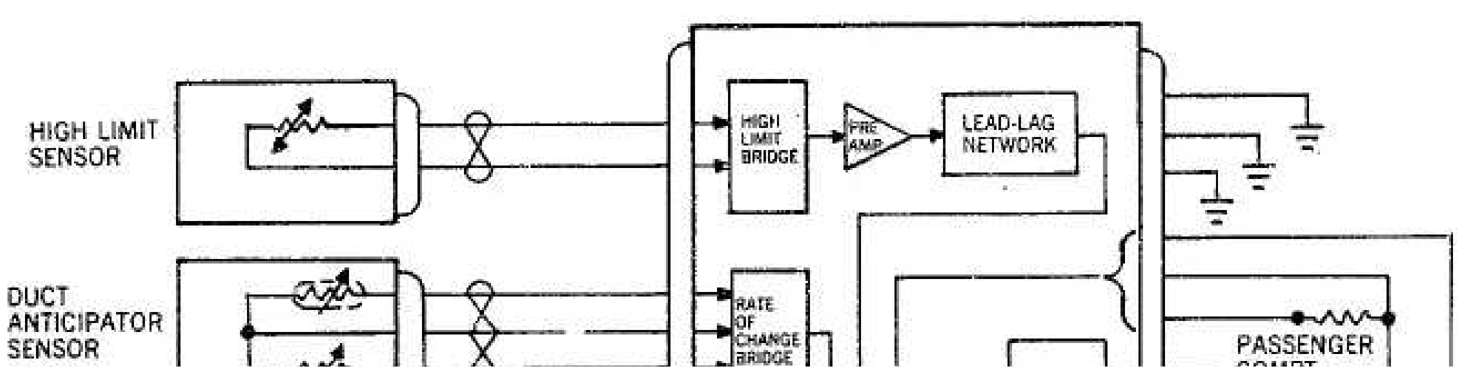
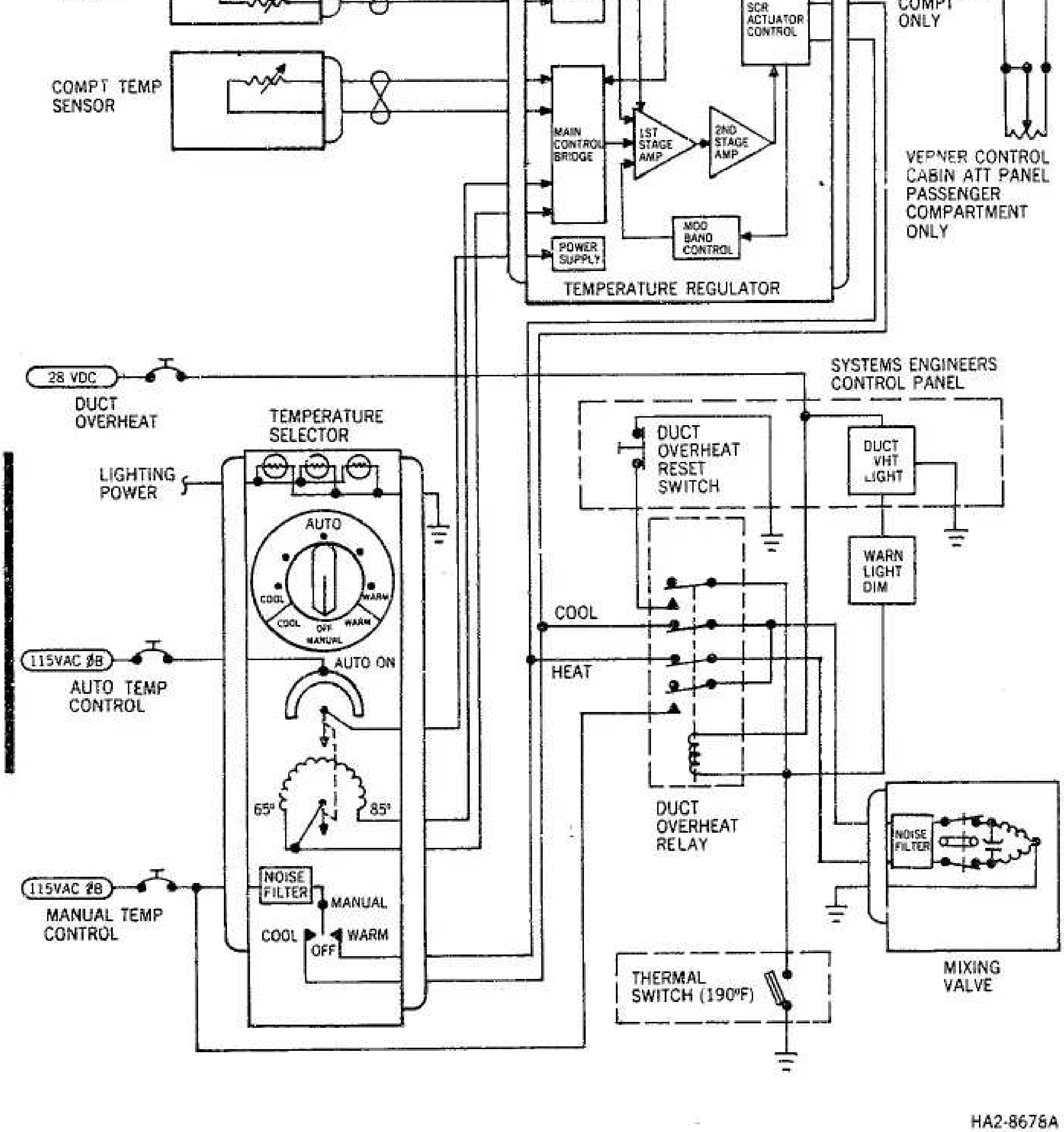
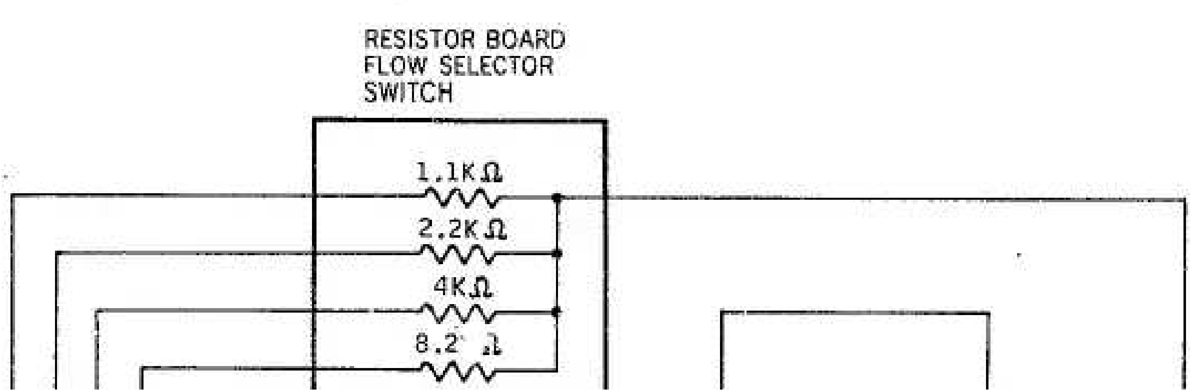
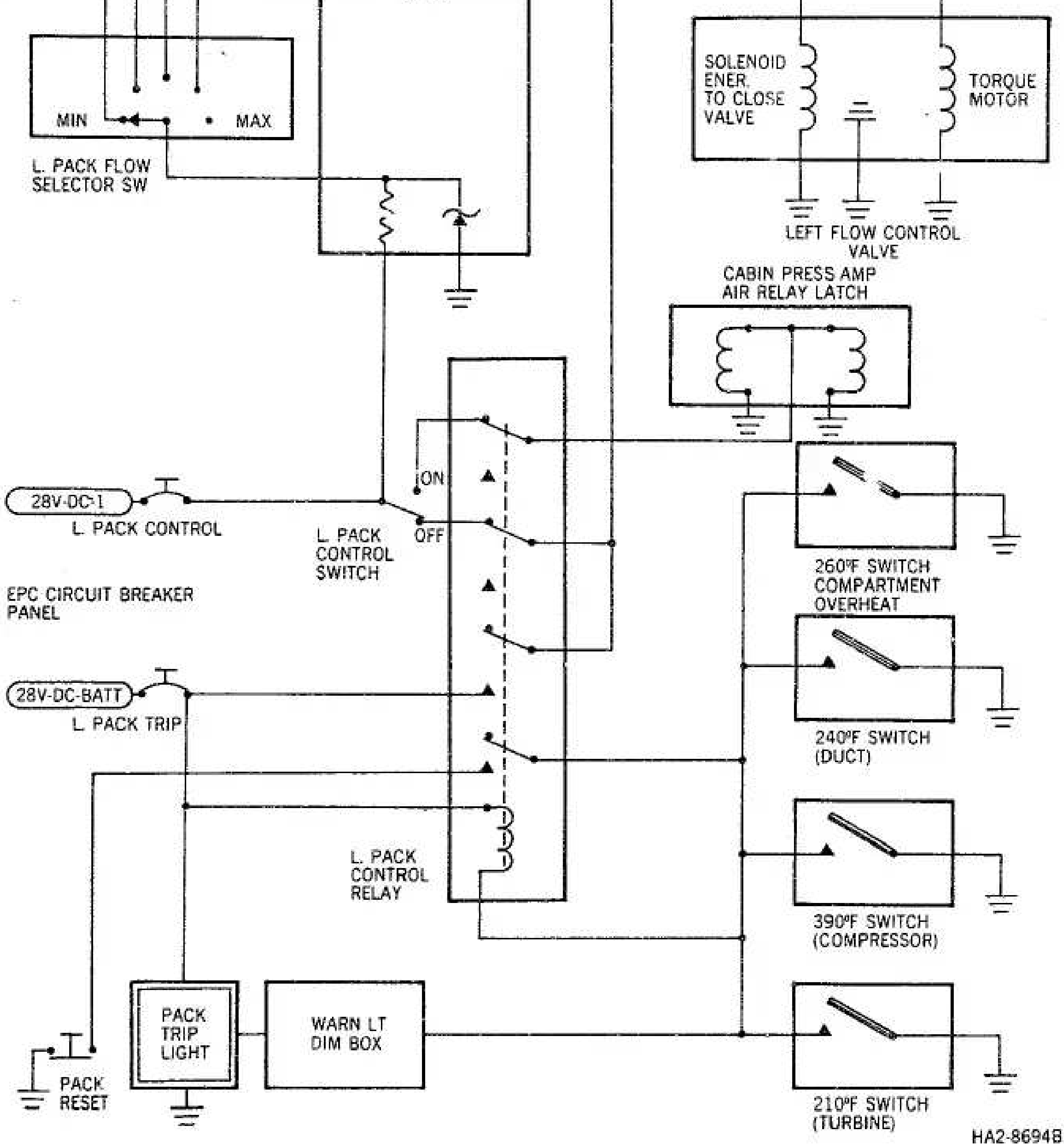




Temperature Control -- Schematic
Figure 6





Pack Flow and Pack Trip -- Schematic
Figure 7

B. When air conditioning switches are turned on the pack valves open and air from the pneumatic system is ducted through and around the cooling packs to the mix valves. The mix valves then adjust to allow the proper proportion of cold air from the packs and hot air from the pneumatic system to enter the distribution system for a selected compartment temperature.

C. If less than maximum cooling capacity is required, the mix valve modulates to allow part of the air fr~m the pneumatic system to bypass the air cycle machine through the intermediate port of the mix valve to flow directly

through the primary and secondary heat exchangers. If full heat is required all the air will bypass the heat exchangers and air cycle machine through the full open hot port of the mix valve with the cold and intermediate ports in the full closed position.

D. Manual control requires monitoring of the passenger compartment and supply duct temperature indicator while adjusting the mix valve position to obtain and hold the desired compartment temperature. With the air conditioning switches on, 115 volt ac current is provided to three switches in the cabin temperature selector. If the selector knob is in the manual OFF position all three switches are open. Moving the knob to cool closes one of the switches and the circuit is completed to move the mix valve such that more air is passed through from the cooling packs and less from the pneumatic system. Moving the knob to warm closes a different switch moving the valve in the opposite direction. Only one of the switches in the selector can be closed at a particular time. A 190°F duct overheat thermal switch gives system protection to prevent adjustment of the mix valve such that air entering the cabin becomes too hot. At approximately 190°F the thermal switch closes, energizing the cabin duct overheat relay. The energized relay completes a circuit to move the mix valve to the full cold position. The thermal switch, when closed, also completes a circuit to turn on the duct overheat light. After correcting the overheat condition the system may be returned to normal by pushing the reset button. Another thermal switch protects against duct overheat should control power be lost. At approximately 240°F this switch closes to energize the pack trip relay and complete a circuit to close the flow control and shutoff valve and turn on the pack trip light. Return to normal after a pack trip requires pushing the pack reset switch after the condition has been corrected (see Figure 7).

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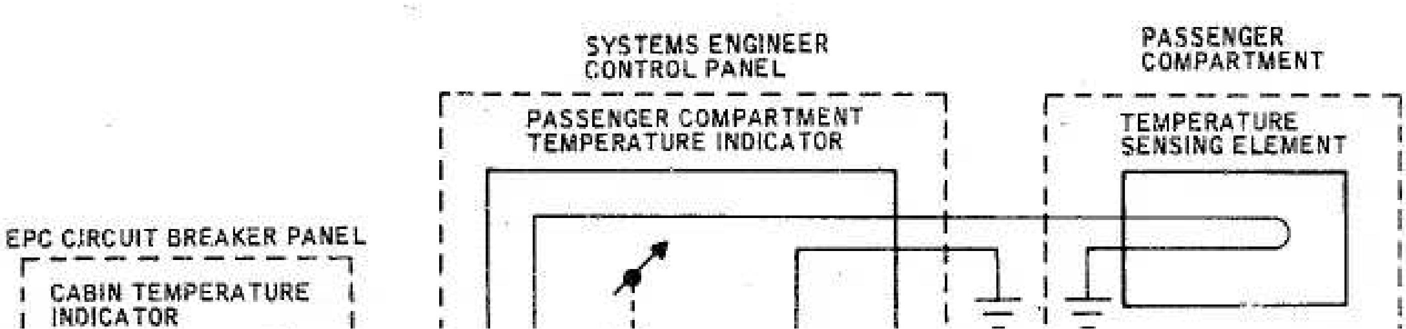
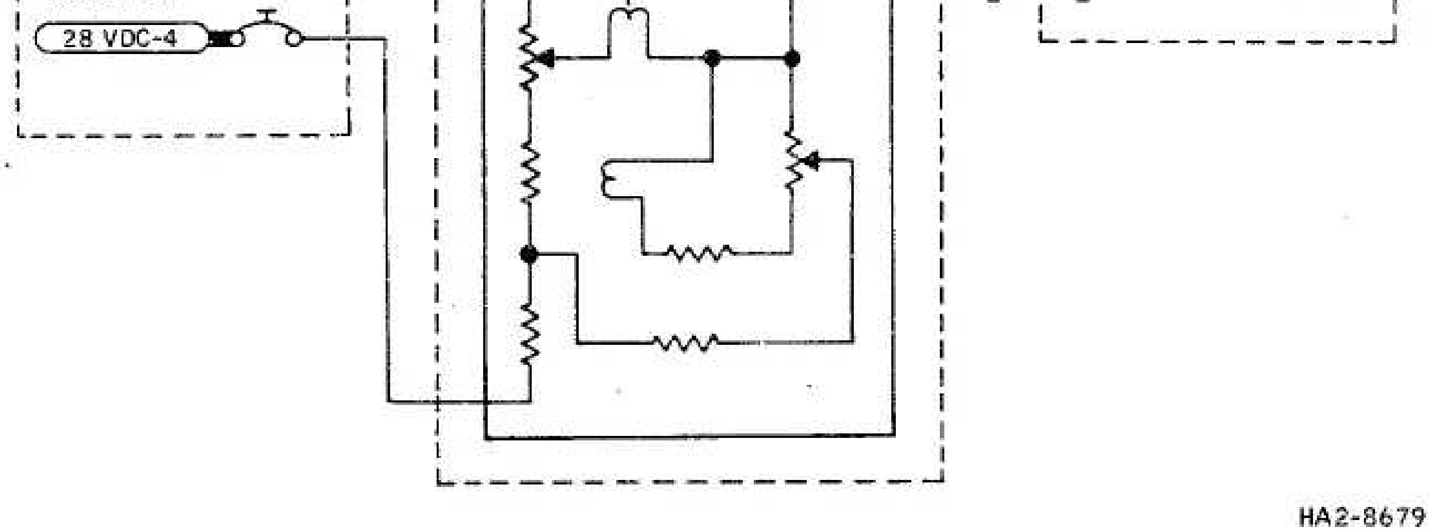
E. When the selector knob is moved to auto the third switch closes and a circuit is completed to the temperature regulator. Setting the knob pointer for a particular compartment temperature adjusts a potentiometer fixed to the knob shaft. This potentiometer combined with the temperature selector at the cabin attendants control panel (passenger compartment only) serves as a reference resistance in the regulator temperature control bridge. The compartment temperature sensor provides the resistance in the other leg of the bridge. If compartment temperature is already the same as that asked for by the selector, the silicon-controlled rectifier actuator control will prevent any current passing on to the mix valve. At a compart-

ment temperature other than that selected the temperature sensor will provide a resistance either higher or lower, depending on whether compartment temperature is below or above that selected, in the other leg of the control bridge. As a result the regulator actuator control will complete a circuit to move the mix valve either toward hot or cold, as required, to bring compartment temperature to agree with selected temperature. The anticipator bridge and the duct temperature limit bridge at the same time sense air temperature as it leaves the mix valve to slow down changes requested by the control bridge and prevent duct overheat. The three bridge circuits feed into a magnetic amplifier which takes the resultant signal to the actuator control. The actuator control then moves the mix valve so that compartment temperature changes without sudden blasts of cold or hot air and without raising duct temperature above limits. The same system overheat protection described under manual control is in effect during automatic control.

F. Air temperature in the passenger compartment is monitored by the temperature indicator (see Figure 8) on the systems engineer's control panel, and manual adjustment can be made to the temperature control systems as required by the operator.





Temperature Indication -- Schematic
Figure 8

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TEMPERATURE CONTROL - TROUBLE SHOOTING

1. General

   A. Temperature control trouble shooting must provide a method for isolating faulty regulating components of automatic temperature control and failures or malfunctions in the manual temperature control system.

B. Each component used during manual control is also used during automatic control. It is practical therefore to check for problems in the manual system before checking the automatic system.

C. As in cooling trouble shooting, indicators and trouble lights on the systems engineer's control panel will provide valuable assistance in trouble shooting temperature control. For example, the mix valve, whose position is set by temperature control, governs cabin air temperature. The 190°F duct overheat thermal switch cuts out temperature control and drives the valve to full cold when a duct overheat condition exists. Should the thermal switch fail closed, temperature control will be lost. At the same time the duct overheat light will come on. Since the duct overheat switch and the left and right pack duct temperature bulbs are located in the same duct a glance at the temperature indicator when the overheat light comes on will confirm that there is a duct overheat condition or will call attention to a faulty duct overheat circuit.

D. Lack of temperature control may be caused by malfunctions in the mix valve, duct overheat relay, or in the relay circuits as well as in the automatic temperature control regulating components.

E. Trouble shooting therefore consists of two steps. First check operation of manual temperature control then check the automatic system. If it is determined by watching airplane instruments that manual control is functioning properly, only the regulating portion of automatic control need be checked.

F. The temperature regulators (controllers) have a built-in test circuit to provide a quick fault isolation capability for electrical components used in the temperature control system. A test switch, two sets of GO, NO GO lights and a test instruction decal are located on the face of the controller. After replacing a faulty component the test must be rerun to assure that condition has been corrected. If problem has not been corrected, check out applicable airplane circuit per wiring diagram and make corrections as necessary. Return switch to START after test is completed.

2. Prepare To Trouble Shoot Temperature Control

A. Provide electrical power.

B. Check that all air conditioning circuit breakers are closed.

C. Check that pack trip light and duct overheat lights are off and press-to-test to assure proper light operation.

D. Move temperature selector to manual warm and check that mix valve moves toward warm by observing mix valve position indicator.

E. If mix valve moves to warm, move selector to manual cool and check that valve moves back to full cold. If mix valve does not move in response to selector setting, check per trouble shooting chart.

F. If mix valve moves in response to manual temperature selection, or if, after a difficulty has been corrected in manual temperature control system, automatic control still doesn't operate correctly, trouble shoot automatic temperature control system.

3. Trouble Shoot Automatic Temperature Control

A. Provide electrical power and perform built-in test equipment (BITE) check per instructions on face of controller. Press on rotary test knob in each position while testing.

4. Trouble Shooting

Possible Causes	Isolation Procedure	Correction
A. MIX VALVE DOES NOT MOVE DURING AUTOMATIC OR MANUAL TEMPERATURE CONTROL.		
(1) Mix valve defective	Disconnect electrical connector from mix valve, and check for power and ground at connector with temperature selector positioned first to WARM then to COOL. If power and ground exist in both positions, valve is defective.	Replace mix valve.

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Possible Causes	Isolation Procedure	Correction
A. MIX VALVE DOES NOT MOVE DURING AUTOMATIC OR MANUAL TEMPERATURE CONTROL. (CONTINUED)		
(2) 190° duct over-	Check duct overheat light	Replace 190° duct

(2) 190° duct overheat switch or cabin duct overheat relay defective.	Check duct overheat light. If on, disconnect overheat switch from wiring, press duct overheat reset switch, and check that light goes off. If light remains off after reset switch is released, 190° duct overheat switch is defective.	Replace 190° duct overheat thermal switch.
	If light comes on after duct overheat reset switch has been released, relay is defective.	Replace duct overheat relay.
	If duct overheat light stays on with 190° duct overheat switch disconnected and duct overheat reset switch pressed, a short circuit exists between light, thermal switch, and relay.	Repair wiring.
	If duct overheat light is off and push-to-test indicates a good light circuit, check for continuity through relay switches. If no continuity between terminals relay is defective.	Replace duct overheat relay.

TEMPERATURE CONTROL - ADJUSTMENT/TEST

1. General

A. Two tests are presented for checking the temperature control system. The first, Functional Test - Temperature Control System, requires only that electrical power be supplied to the airplane and guarantees the electrical continuity and functional ability of all components of the systems. The

continuity and functional ability of all components of the systems. The second, Test Temperature Control System Operation, requires operation of cooling packs which means that in addition to electrical power the pneumatic system must be pressurized. This check also proves the system to be operationally correct, however it checks only the response to normal operation.

B. Temperature regulators (controllers) have built-in-test (BIT) equipment to permit a quick check of controller electrical equipment. Refer to temperature control trouble shooting for BIT equipment usage.

2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Temp Cal probe heater	Attachment to Jet Cal engine analyzer		Heat temperature bulbs
B	Controlled cooling source			Cool temperature bulbs

3. Functional Test - Temperature Control Systems

A. Prepare to Test Temperature Control

(1) Provide electrical power.

(2) Check that all air conditioning circuit breakers are closed (see 21-00).

B. Test Manual Temperature Control

(1) Position temperature indicator selector to each of its positions in sequence and check that each reads approximately the same.

(2) Move selector knob to left pack position.

(3) Remove flight compartment duct temperature bulb, apply heat to the bulb and check that temperature indicator reading goes up. Do not heat temperature bulb enough to cause the indicator to go off scale.

CAUTION: IF TEMPERATURE APPLIED IS ENOUGH TO CAUSE INDICATOR NEEDLE TO MOVE PAST ITS LIMIT, THE UNIT MAY BE DAMAGED.

NOTE: As an alternate method, hot or cold air may be blown across temperature bulb to raise or lower bulb temperature.

(4) Move temperature indicator selector knob to each position and repeat increased temperature check on respective temperature bulb per step (3).

(5) Observe cabin temperature indicator and repeat increased temperature check on passenger compartment temperature bulb per step (3).

(6) Hold the temperature selector knob to manual warm until the mix valve indicator moves to full hot.

NOTE: Full hot is indicated when the pointer aligns with the inner of the two closely spaced index marks at hot end of the indicator scale. Full cold is at the inner of the two closely spaced index marks at the other end of the scale.

(7) Check that indicator on mixing valve is at full hot position.

(8) Hold temperature selector to manual cool position until indicator reads full cold.

(9) Check that indicator on mixing valve is at full cold.

(10) If position indicator on systems engineer's control panel does not align with either hot or cold index mark adjust the mix valve position transmitter (see 21-56-6, Position Indicator Control Unit).

CAUTION: DO NOT USE LOW IMPEDANCE OHMMETER FOR CHECKING THE POSITION TRANSMITTER. THE TRANSMITTER IS A SENSITIVE VARIABLE RESISTANCE ELEMENT WHICH WILL BE DAMAGED BEYOND REPAIR IF SUBJECTED TO HIGH CURRENT.

C. Test Automatic Temperature Control

(1) General

(a) Testing the automatic temperature control provides a check that the sensing devises in the regulation system, the temperature selector, the temperature regulator, and the mixing valve are functioning properly.

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(b) The range of cabin temperature selected lies between 65°F (18°C) and 85°F (30°C). The cabin temperature sensor will be approximately ambient temperature. It is necessary therefore to provide a slighly different method for checking the system when ambient temperature is below 65°F or above 85°F. Step (2) describes the test requirements determined by ambient temperature and assumes that inside the cabin the temperature is approximately ambient.

(c) This test applies to both the passenger compartment and the flight

compartment temperature control systems.

(2) Position the mixing valve to an intermediate position.

(a) Move the temperature selector knob to manual warm or manual cool while observing mixing valve position on the indicator. When the mixing valve reaches approximately its midposition, move the selector knob back to off.

(b) When ambient temperature is below 65°F (18°C) apply a controlled heat source to compartment temperature sensor and set it at approximately 75°F (24°C). When ambient temperature is above 85°F (30°C) apply a controlled cold air source to compartment temperature sensor until it's temperature is approximately 75°F. If ambient temperature is between 65°F and 85°F proceed with step (c).

NOTE: The temperature scale in the automatic temperature range of the temperature selector covers 20°F (11.1°C) from 65°F to 85°F and each index mark is 5°F (2.8°C) separated from thc adjacent index mark.

(c) Move temperature selector knob until pointer is approximately straight up then make fine adjustment with knob such that mixing valve stops its movement.

NOTE: While making fine adjustment observe mix valve position indicator. If reading on indicator shows mix valve moving toward hot turn selector knob counterclockwise. If valve is moving toward cold, adjust knob clockwise. If ambient temperature is between 65°F and 85°F, the null setting on the selector should be within $\pm$ 1.5°F ($\pm$ 0.83°C) of ambient temperature.

(3) Move temperature selector knob counterclockwise from the null position approximately 2°F (1.1°C) and check that mix valve moves toward cold.

NOTE: 2°F movement on the selector scale corresponds to just less than half the distance between index marks.

(4) Return mix valve to intermediate position per step (2).

(5) Move selector clockwise approximately 2°F (1.1°C) and check that mix valve moves toward hot.

(6) Return mix valve to intermediate position per step (2).

(7) Remove the duct temperature limit sensor from the main distribution manifold.

(8) Apply heat to duct temperature limit sensor probe and check that mix valve drives to full cold.

NOTE: At approximately 1^0°F (60°C) the mix valve will start toward the

cold position.

(9) Allow sensor to cool until it may comfortably be held by bare hand, then reinstall in main distribution manifold.

(10) Reposition the mix valve per step (2).

(11) Check that when the duct overheat light is pushed, it comes on, and when it is released, it goes out.

(12). Remove 190° duct overheat thermal switch from main distribution manifold.

(13) Heat 190° duct overneat switch to 195°F (90.6°C) and check that duct overheat light comes on.

CAUTION: USE CONTROLLED HEAT SOURCE ONLY. AN UNCONTROLLED SOURCE MAY HEAT SWITCH ENOUGH TO CAUSE PERMANENT DAMAGE TO SWITCH AFTER LIGHT COMES ON.

(14) Check that mix valve drives to full cold.

(15) After allowing sufficient time for overheat switch to cool, push duct overheat reset switch, and check that duct overheat light goes out.

(16) Reinstall 190° duct overheat switch.

(17) Hold temperature selector knob to manual warmer until mix valve moves from full cold, then release.

(18) Remove all test equipment from airplane.

(19) Remove electrical power if no longer required.

4. Test Temperature Control System Operation

A. General

(1) The operational test of the temperature control system requires that the pneumatic system be pressurized.

(2) Prior to running the test it should be determined that the pneumatic system, cooling packs, and ram air systems are functionally correct without excessive leakage from the air supply ducts.

(3) The operational test is for flight compartment temperature control system as well as the passenger compartment but only one system may be checked at a time.

B. Test Temperature Control System

(1) Provide electrical power.

(2) Pressurize the pneumatic system and open valves as required to provide air supply to the flight or passenger compartment air conditioning system being tested (see Chapter 36).

(3) Check that all air conditioning circuit breakers are closed (see 21-00).

(4) Check mix valve position by observing the mix valve indicator.

NOTE: The indicator is reading full cold when the pointer aligns with the inner of the two closely spaced index marks at the COLD end of the indicator scale. Full hot is at the inner of the two closely spaced index marks at the other end of the scale.

(5) Observe cabin temp indicator and record temperature.

NOTE: The flight compartment temperature may be taken as approximately the same as the passenger compartment when checking flight compartment temperature control.

(6) Check automatic temperature control using appropriate method according to existing compartment temperature.

(a) Check automatic temperature control when existing compartment temperature is below 83°F (28.3°C).

1) Set temperature selector a few degrees above compartment temperature as recorded in step (5).

2) Move pack switch to on.

3) Check that mix valve moves toward HOT.

(b) Check automatic temperature control when existing compartment temperature is above 83°F (28.3°C).

1) Move temperature selector knob to 85°F (30°C) if compartment temperature is above 85°F. If compartment temperature is between 83°F and 85°F, set the selector at compartment temperature.

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2) Move pack switch to on.

3) Check that mix valve moves to full cold position.

4) Move selector knob to manual warm and check that mix valve drives toward hot.

5) Move the selector knob back to the automatic range at a setting below cabin temperature.

6) Check that the mix valve moves to the full cold position.

(7) Check that air is entering the compartment by feel at the compartment inlet ducts.

(8) Move selector knob to manual warm and check by feel at the compartment inlet ducts, that the air entering the compartment becomes warmer.

(9) Move selector knob to manual cool while checking, by feel, that the air entering the compartment becomes cooler.

(10) Move pack switch to off.

(11) Remove pneumatic system pressure if no longer required (see Chapter 36).

(12) Remove electrical power if no longer required.

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MIX VALVE - REMOVAL/INSTALLATION

1. General

A. Two 3-way electric motor-driven valves are provided to mix cool air from the cooling packs with hot engine bleed air.

B. Access to the mix valves is through the air-conditioning accessory compartment lower fuselage access doors.

2. <u>Removal/Installation Left Mix Valve</u> (See Figure 401)

A. Remove Left Mix Valve

(1) Open cockpit auto temp control and cockpit manual temperature control circuit breakers located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Remove electrical connector and bonding jumper.

(3) Remove V-band couplings from mix valve hot, cold and intermediate air inlet ports and flexible connector from outlet port.

(4) Remove support rods from mix valve.

(5) Lower mix valve from air-conditioning accessory compartment.

B Install Left Mix Valve

(1) Raise mix valve into position with linkage on bottom of valve.

(2) Connect support rods to mix valve.

(3) Align mix valve inlet and outlet ports with ducts and install all couplings but do not tighten.

(4) Check that all joints are aligned and tighten couplings.

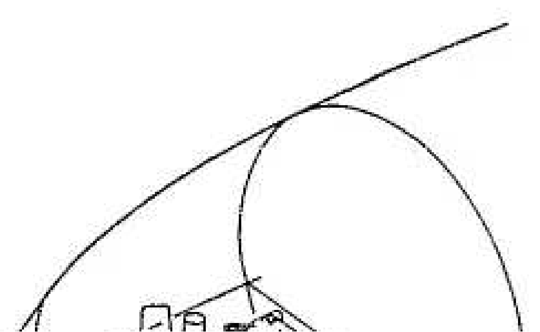
(5) Install mix valve actuator electrical connector.

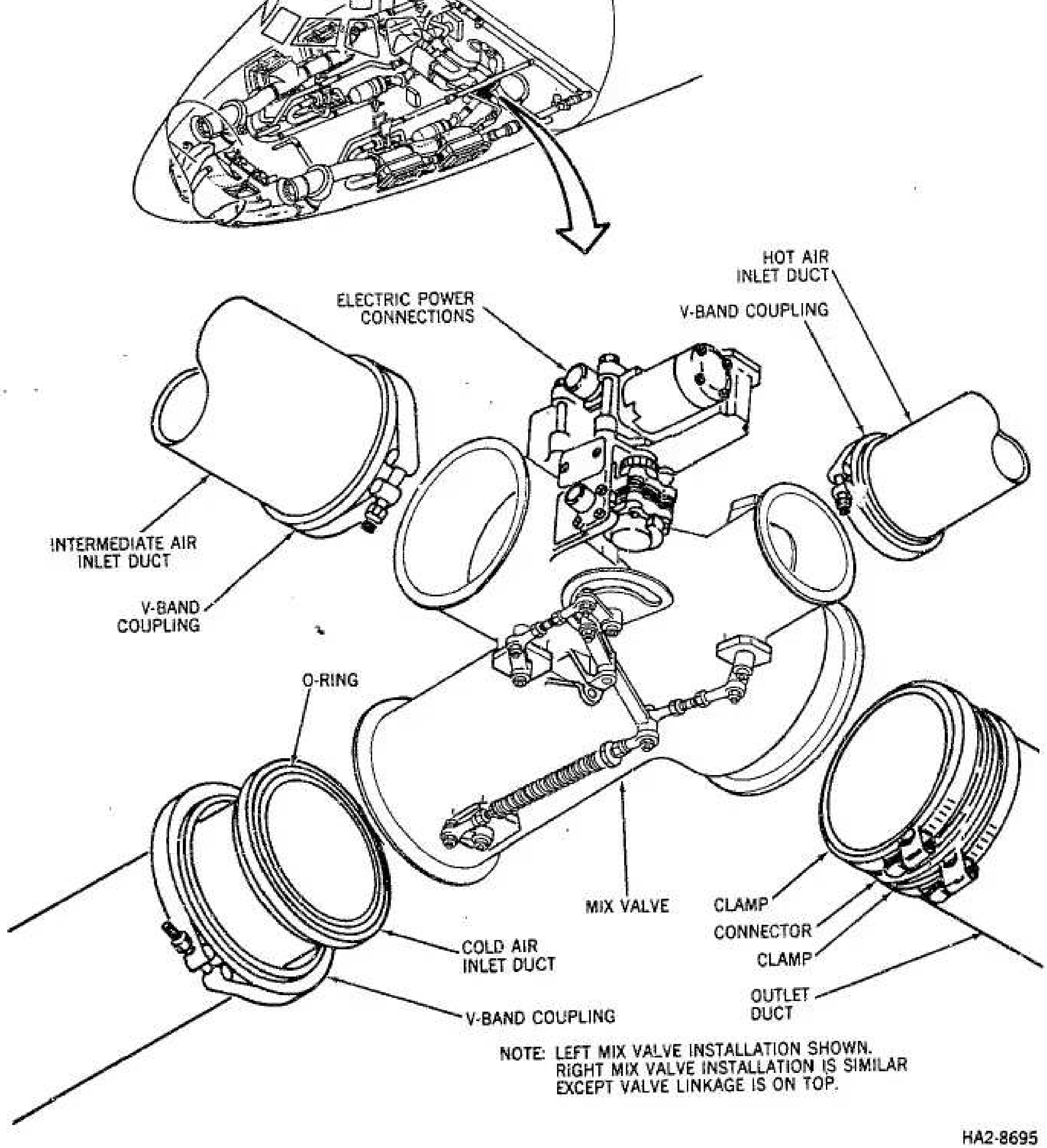
(6) Clean bonding surfaces and connect bonding jumper to mix valve.

(7) Close cockpit manual temperature control and cockpit auto temperature control circuit breakers.

(8) Check mix valve installation (see paragraph 4).

TOC





Mix Valve--Installation
Figure 401

3. Removal/Installation Right Mix Valve (See Figure 401)

   A. Remove Right Mix Valve

      (1) Open cabin auto temp control and cabin manual temp control circuit breakers located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Remove electrical connector and bonding jumper.

(3) Remove V-band couplings from mix valve hot, cold and intermediate air inlet ports and flexible connector from outlet port.

(4) Remove support rods from mix valve.

(5) Lower mix valve from air-conditioning accessory compartment.

B. Install Right Mix Valve

(1) Raise mix valve into position with linkage on top of valve.

(2) Connect support rods to mix valve.

(3) Align mix valve inlet and outlet ports with ducts and install all couplings but do not tighten.

(4) Check that all joints are aligned and tighten couplings.

(5) Install mix valve actuator electrical connector.

(6) Clean bonding surfaces and connect bonding jumper to mix valve.

(7) Close cabin manual temperature control and cabin auto temperature control circuit breakers.

(8) Check mix valve installation (see paragraph 4).

4. Test Mix Valve Installation

A. Provide electrical power.

B. Check that all air conditioning and pneumatic systems circuit breakers are closed (see 21-00).

C. Pressurize pneumatic system (see Chapter 36).

D. Open entry door or flight compartment window.

E. Move applicable pack switch to up position.

F. Place applicable cabin temperature selector in auto.

G. Check for leakage at all couplings disturbed during removal/installation. Diffused leakage is allowed, jet blasts are not.

WARNING: DO NOT ATTEMPT TO REPAIR JET BLAST LEAKAGE WITH PACKS ON OR PERSONNEL MAY BE INJURED.

H. Move pack switch to off.

I. Remove pneumatic pressure if no longer required.

J. Remove electrical power if no longer required.

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FLIGHT AND PASSENGER COMPARTMENT TEMPERATURE SENSING ELEMENT - MAINTENANCE PRACTICES

1. General

A. The flight compartment temperature sensing element is located on the for-

ward face of the first offi er's foot rest. The passenger compartment sensing element is located on the forward face of the aft drop ceiling.

B. Access to the passenger compartment sensing element is through the passenger compartment aft drop ceiling panel.

2. <u>Removal/Installation Flight and Passenger Compartment Temperature Sensing Element</u>

A. Remove Flight Compartment Temperature Sensing Element

(1) Open cockpit auto temperature control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Disconnect electrical connector from sensing element.

(3) Remove sensing element from clips.

B. Install Flight Compartment Temperature Sensing Element

(1) Make certain cockpit auto temperature control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel, is open.

(2) Install sensing element in clips.

(3) Connect electrical connector and safety with lockwire.

(4) Close cockpit auto temperature control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(5) Test flight compartment temperature sensing element by performing system BITE test as shown on face of the temperature controller.

C. Remove Passenger Compartment Temperature Sensing Element

(1) Open cabin auto temperature control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

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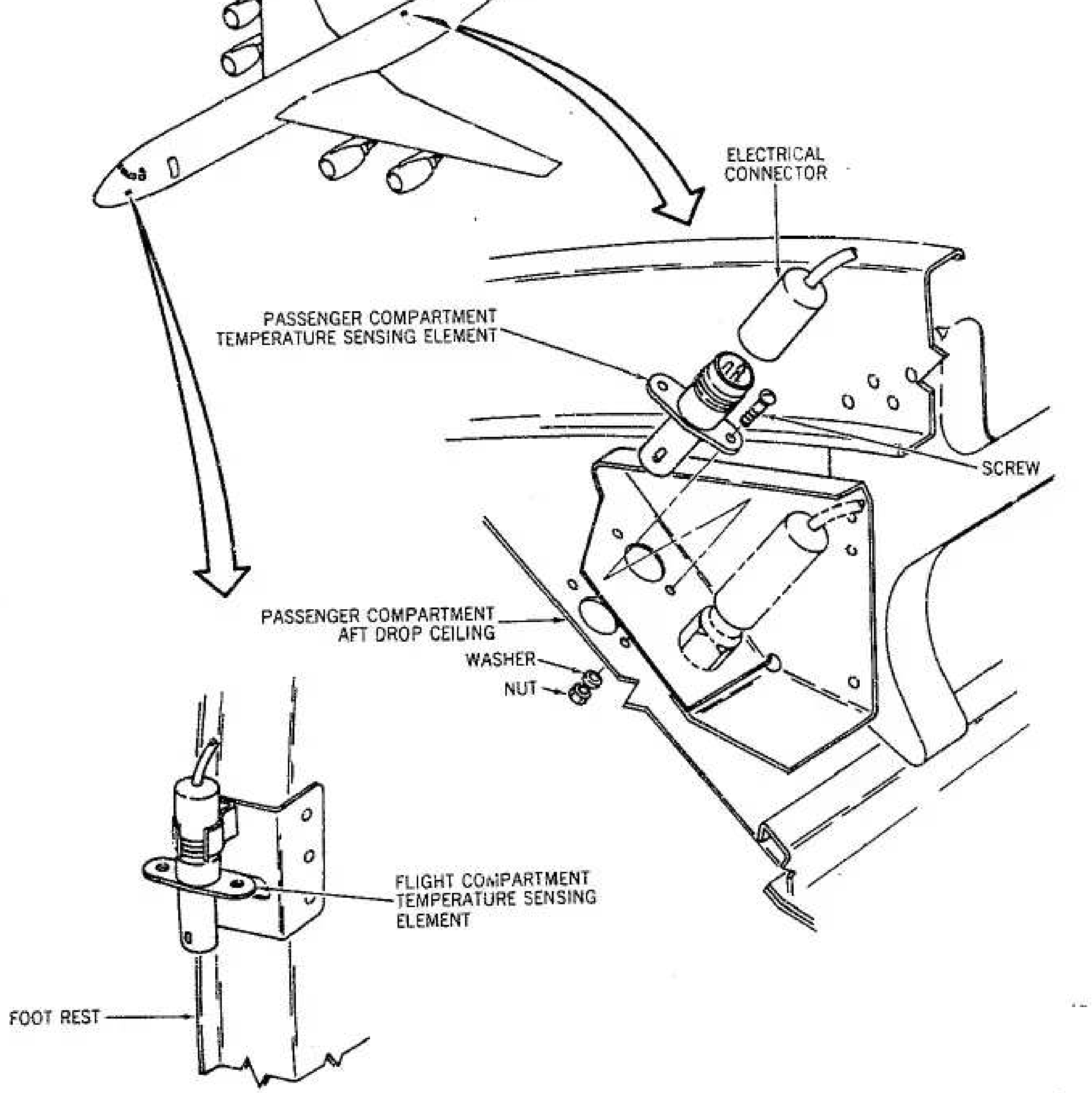

Flight and Passenger Compartment Temperature
Sensing Element -- Installation
Figure 201

(2) Remove sensing element from aft drop ceiling.

(3) Disconnect electrical connector from sensing element.

D. Install Passenger Compartment Temperature Sensing Element

(1) Make certain cabin auto temperature control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker

panel, is open.

(2) Connect electrical connector and safety with lockwire.

(3) Install sensing element in aft drop ceiling.

(4) Close cabin auto temperature control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(5) Perform temperature control system BITE test as shown on face of the temperature controller.

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PASSENGER COMPARTMENT TEMPERATURE INDICATING COMPONENTS - MAINTENANCE PRACTICES

1. General

A. The passenger compartment temperature indicating components consist of the

passenger compartment temper·ture indicator and the sensing element.

B. The passenger compartment temperature indicator is located on the lower left panel of the systems engineer control panel. The temperature sensing element is located on the forward face of the aft drop ceiling.

C. Access to the temperature indicator is through the systems engineer control panel. Access to the passenger compartment sensing element is through the passenger compartment aft drop ceiling panel.

2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Mild detergent		Local	Clean temperature indicating sensors
B	Metal stem thermometer		Local	Measure temperature in compartment

3. Servicing Passenger Compartment Temperature Indicating Components

A. Clean Sensor

(1) Remove sensor (see paragraph 4).

(2) Clean outside of sensor with mild detergent solution.

(3) Rinse sensor in clean water and wipe dry.

(4) Install sensor (see paragraph 4).

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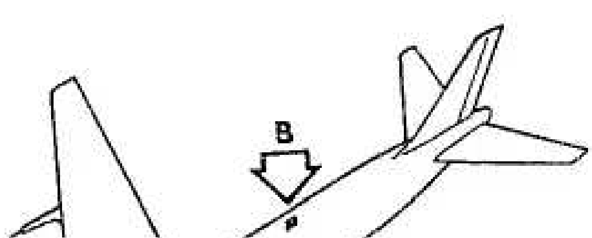

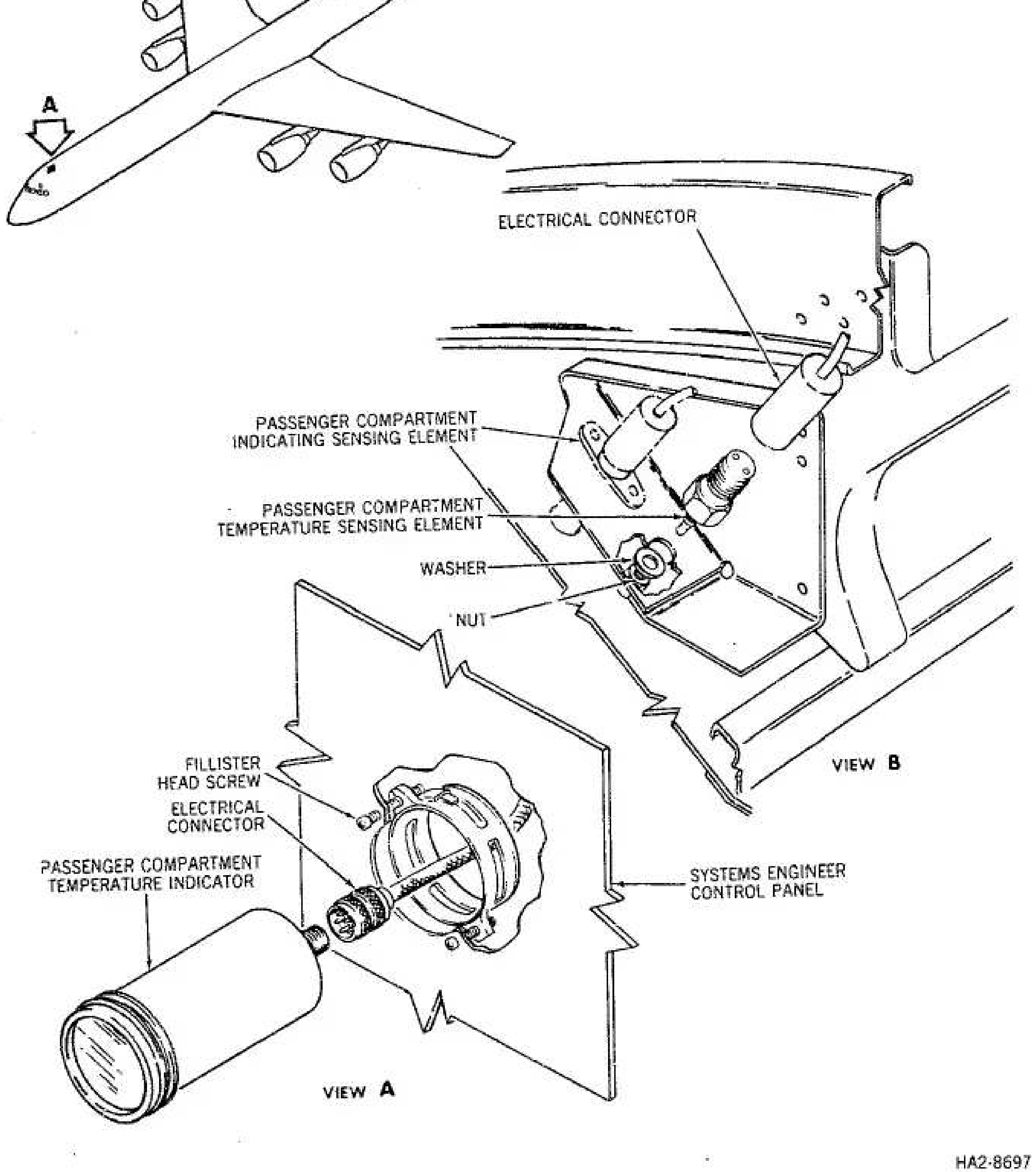

Passenger Compartment Temperature Indicating
Components -- Installation
Figure 201

4. Removal/Installation Passenger Compartment Temperature Indicating Components

Remove Indicator

(1) Open cabin temperature indicator circuit breaker, located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker panel.

(2) Open systems engineer panel red light circuit breaker, located on light-

ing (ac bus) section of EPC circuit breaker panel.

(3) Loosen fillister-head screws that secure indicator to systems engineer control panel.

(4) Pull indicator forward, and disconnect electrical connector.

(5) Remove indicator.

B. Install Indicator

(1) Make certain cabin temperature indicator circuit breaker, located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker panel, is open.

(2) Make certain systems engineer panel red light circuit breaker, located on lighting (ac bus) section of EPC circuit breaker panel, is open.

(3) Connect electrical connector to indicator.

(4) Install indicator and tighten fillister-head screws that secure indicator to systems engineer control panel.

(5) Close cabin temperature indicator circuit breaker, located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker panel.

(6) Close systems engineer panel red light circuit breaker, located on lighting (ac bus) section of EPC circuit breaker panel.

(7) Test Indicator (see Adjustment/Test).

C. Remove Sensing Element

(1) Open cabin temperature indicator circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Loosen attaching nut, and remove sensing element.

(3) Disconnect electrical connector.

D. Install Sensing Element

(1) Make certain cabin temperature indicator circuit breaker, located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker panel, is open.

(2) Connect electrical connector.

(3) Install sensing element, and tighten attaching nut.

(4) Close cabin temperature indicator circuit breaker, located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker panel.

(5) Test sensing element (see Adjustment/Test).

5. Adjustment/Test Passenger Compartment Temperature Indicating Components

A. Test Passenger Compartment Temperature Indicating Components

(1) Place thermometer in vicinity of temperature sensing element.

(2) Compare temperature, as measured by thermometer, to indicator reading. Temperature should correspond within 2 degrees.

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TEMPERATURE REGULATOR - REMOVAL/INSTALLATION

1. General

A. Flight and passenger compartment automatic temperature regulation is obtained from a single unit. The regulators (temperature controllers) utilize a built-in test circuit to provide a quick electrical check of

temperature control system components. A rotary test switch, two sets of GO, NO GO lights and a test instruction decal are provided on the face of the controller. Press on rotary knob in each position while testing, and return to start position when test complete.

B. Access to the temperature regulator is through the air-conditioning accessory compartment lower fuselage access doors.

2. <u>Removal/Installation Temperature Regulator (See Figure 401)</u>

A. Remove Temperature Regulator

(1) Open following circuit breakers located on EPC circuit breaker panel.

Circuit Breaker	Panel Section
Cockpit manual temperature control	Heat, vent, and ice protection (ac bus)
Cabin manual temperature control	Heat, vent, and ice protection (ac bus)
Cockpit auto temperature control	Heat, vent, and ice protection (ac bus)
Cabin auto temperature control	Heat, vent, and ice protection (ac bus)

(2) Loosen knurl nut.

(3) Remove temperature regulator.

B. Install Temperature Regulator

(1) Install temperature regulator.

(2) Tighten knurl nut.

(3) Close circuit breakers opened in step A.(1).

(4) Test temperature control system operation (see 21-60-0, Temperature Control) and perform BITE instructions shown on face of the controller.

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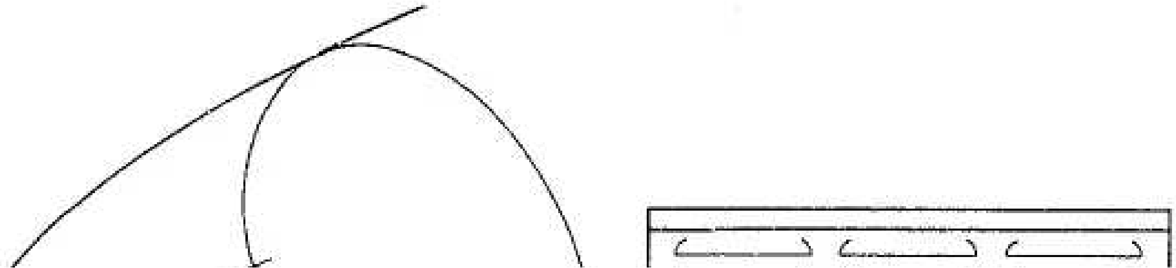

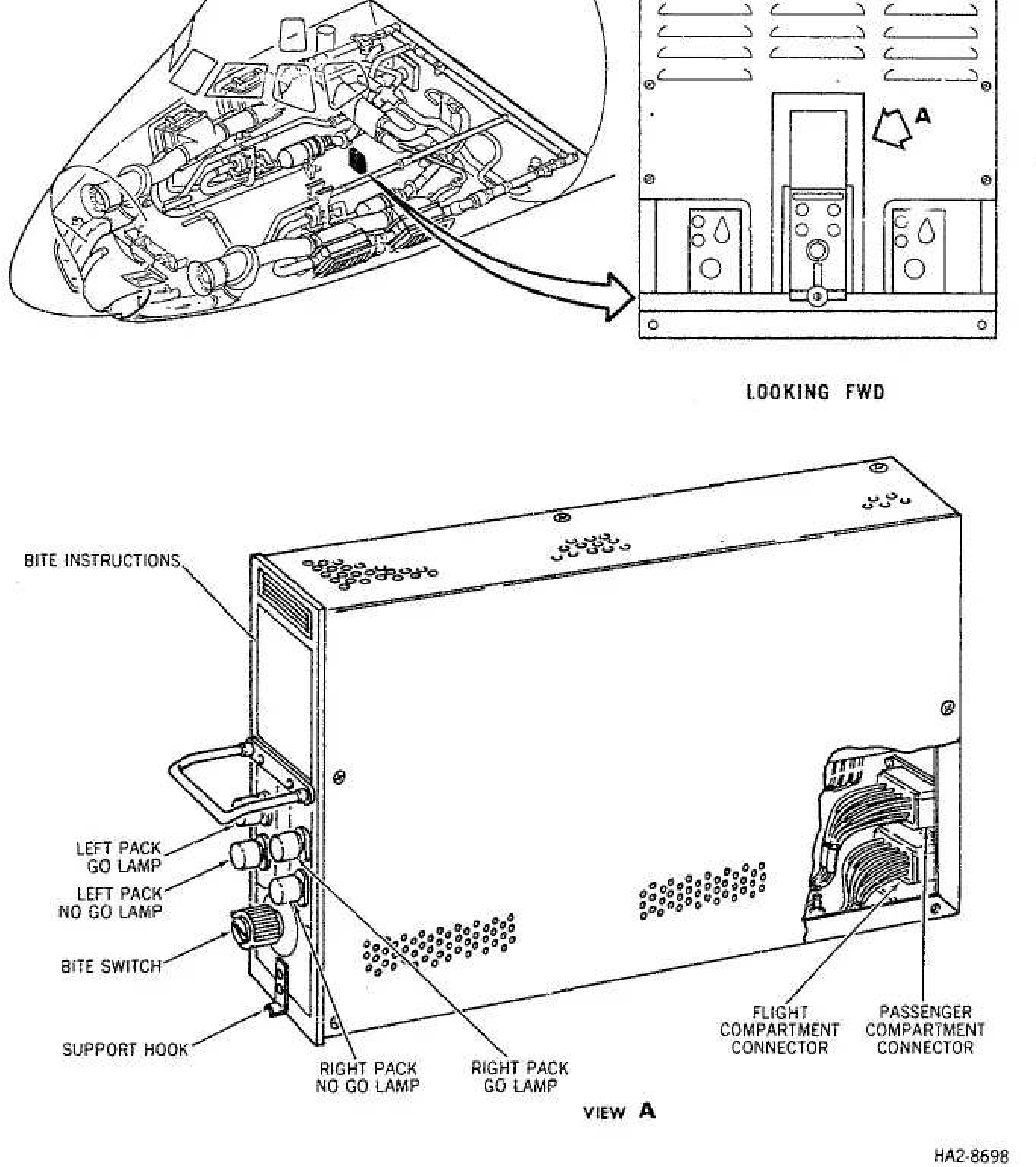

Temperature Regulator -- Installation
Figure 401

TOC

DUCT TEMPERATURE SENSORS - REMOVAL/INSTALLATION

1. General

A. There are four duct temperature sensors consisting of a duct temperature

limit sensor, and a cabin anticipator sensor for each system. The anticipator and duct limit sensor are in the main distribution manifold.

B. Access to the sensing elements is through the air-conditioning accessory compartment lower fuselage access doors.

C. Removal and installation procedures for both sensing elements are identical.

2. <u>Removal/Installation Duct Temperature Sensing Element (See Figure 401)</u>

A. Remove Duct Air Temperature Sensor

(1) Open applicable auto temperature control circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Disconnect electrical connector from temperature sensor.

(3) Remove screws attaching sensor to duct.

(4) Remove sensor.

B. Install Duct Air Temperature Sensor

(1) Position sensor on duct and install attaching screws.

(2) Connect electrical connector to sensor receptacle.

(3) Close auto temperature control circuit breaker opened in step A.(1).

(4) Test temperature control system operation per BITE instructions shown on face of the temperature controller. Press on rotary knob in each position while testing and return to start position when test is complete.

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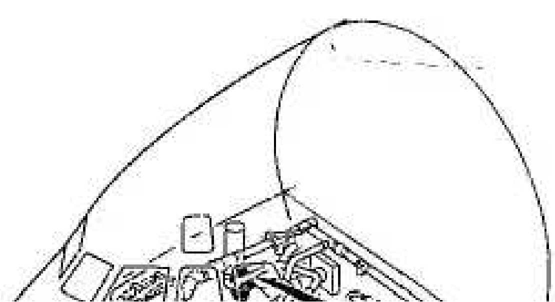

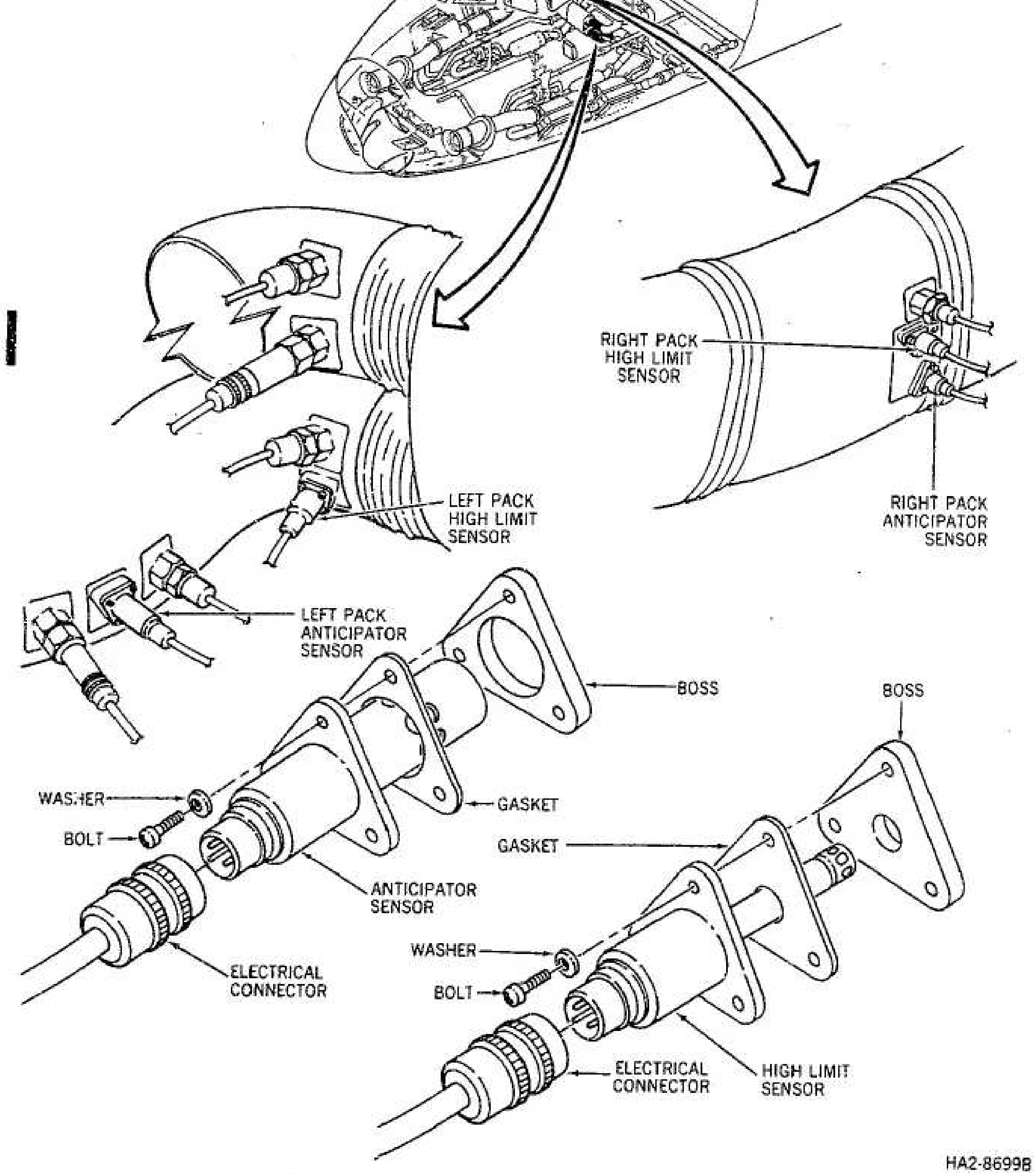

Duct Temperature Sensors
Figure 401

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DUCT OVERHEAT SWITCHES - REMOVAL/INSTALLATION

1. General

A. The conditioned air duct overheat switches for the flight and passenger compartments are installed in the distribution ducts downstream of the

mixing valves. There are four overheat switches, a 190°F (88°C) and a 240°F (115.5°C) overheat swi_ch for each system.

B. Access to the sensing switches is through the air-conditioning accessory compartment lower fuselage access doors.

C. Removal and installation procedures for both sensing switches are identica

2. Equipment and Materials

A. Controlled Heat Source - Temp Cal probe heater (Attachment to Jet Cal engine analyzer).

3. Removal/Installation Duct Overheat Switch (See Figure 401)

A. Remove Duct Overheat Switch

(1) Open applicable duct overheat circuit breaker, located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker panel.

(2) Open applicable pack trip circuit breaker, located on battery bus (dc bus) section of EPC circuit breaker panel.

(3) Disconnect electrical connector from switch.

(4) Remove switch and O-ring.

B. Install Duct Overheat Switch

(1) Make certain applicable duct overheat or pack trip circuit breaker is open.

(2) Connect electrical connector to duct overheat switch.

(3) Test duct overheat thermal switch operation.

(a) Connect external electrical power.

(b) Close applicable duct overheat or pack trip circuit breaker.

(c) Push-to-test duct overheat light for 190°F switch or pack trip light for 240°F switch replacement.

(d) Apply heat to thermal switch probe and observe that respective light comes on.

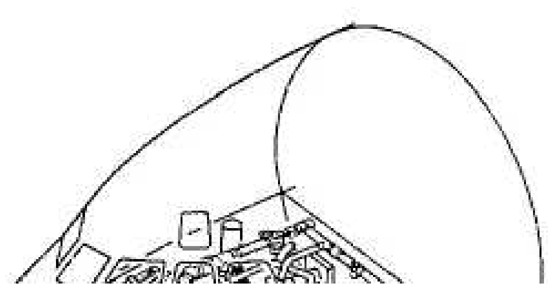
NOTE: Duct overheat light should illuminate at a probe temperature of

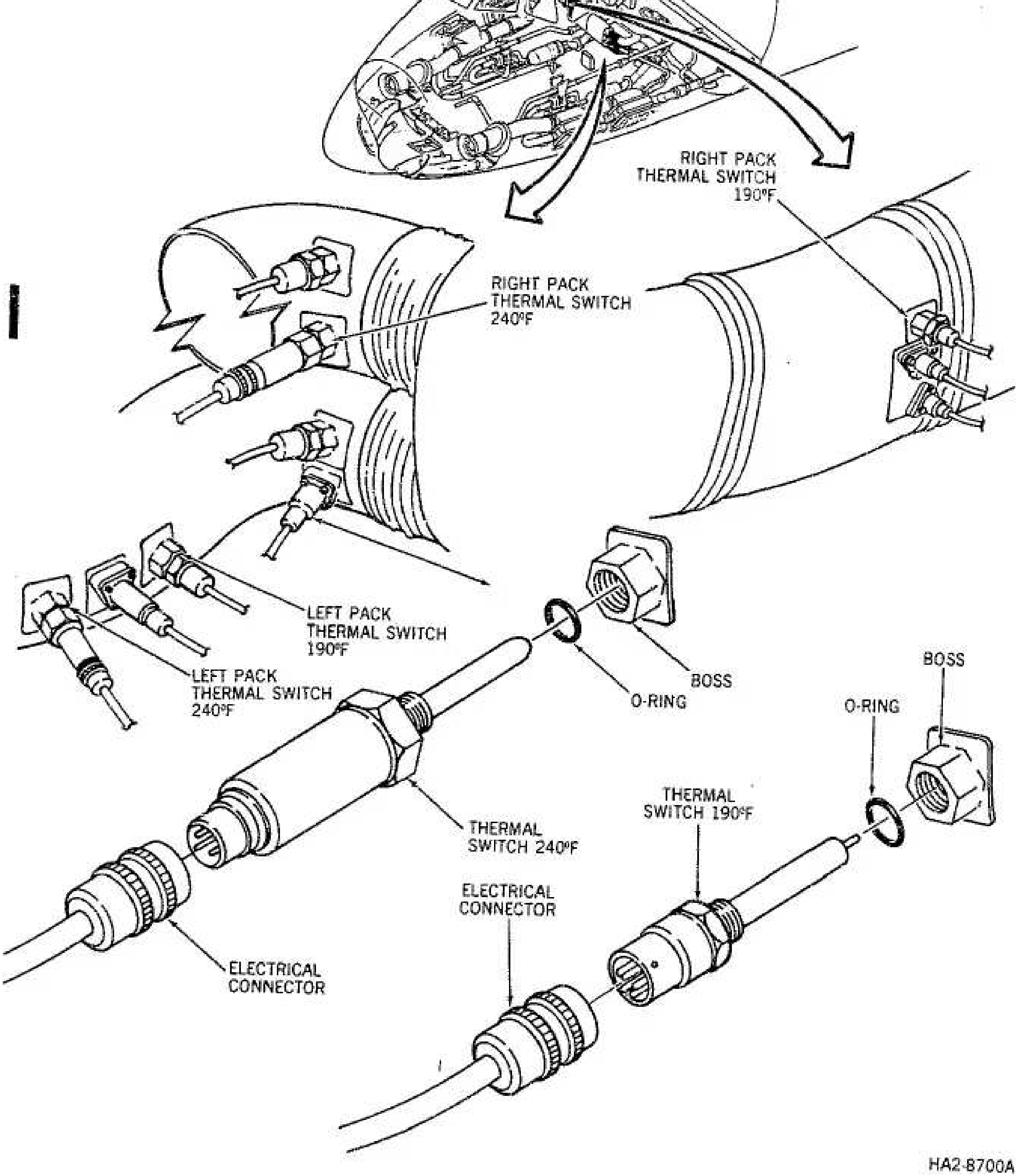
approximately 190°F (88°C) and pack trip off light at approximately 240°F (115.5°C).

(e) Allow sufficient time for probe to cool; then push reset switch for applicable system and check that light goes out.

(f) Remove electrical power if no longer required.

(4) Install O-ring on thermal switch, install switch into duct receptacle.





Duct Overheat Switch--Installation
Figure 401

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TEMPERATURE INDICATING - DESCRIPTION AND OPERATION

1. General

   A. The temperature indicating systems permit monitoring passenger compartment

temperature and provide information needed to regulate the ram air exhaust louver door system. The systems also provide the systems engineer an early warning of troubles in the cooling packs or air supply and assist in trouble shooting the air conditioning system. The systems are not intended as a means for checking accuracy of the various thermal switches and sensors used in air conditioning but may aid in checking proper function of control circuits.

B. Temperature indicating includes four separate temperature indicating systems. The systems are; two compressor discharge indicating systems, one for each cooling pack, an air temperature indicating system for cabin air supply temperature, left and right pack conditioned air temperature and cargo compartment temperature. Passenger compartment temperature indicating is discussed in section 21-60-0.

C. Each compressor discharge indicating system includes an indicator and a temperature bulb. The air temperature indicating system includes two temperature bulbs for pack temperatures, one bulb for air supply temperature, one temperature bulb for cargo compartment temperature, one temperature indicator, and a temperature indicator selector. (see Figure 1.)

D. Temperature bulbs are discussed in sections 21-55-0, cooling packs, and 21-60-0, temperature control. It should be noted however, that the slight lag in temperature indicating systems with respect to thermal switch overheat protection of cooling packs and temperature control and the location of temperature bulbs prevents the use of the temperature indicating systems for checking out accuracy of the other thermal sensing devices. The temperature bulb in the air supply duct is for sensing air temperature before it enters the compartment. Air temperature at this location is a result of the position of both mix valves. Since flight compartment and passenger compartment temperature requirements are likely to be different, supply temperature does not reflect either pack condition so long as both are operating. A malfunction in either pack however, which causes a sudden temperature change, will be noted on the indicator.

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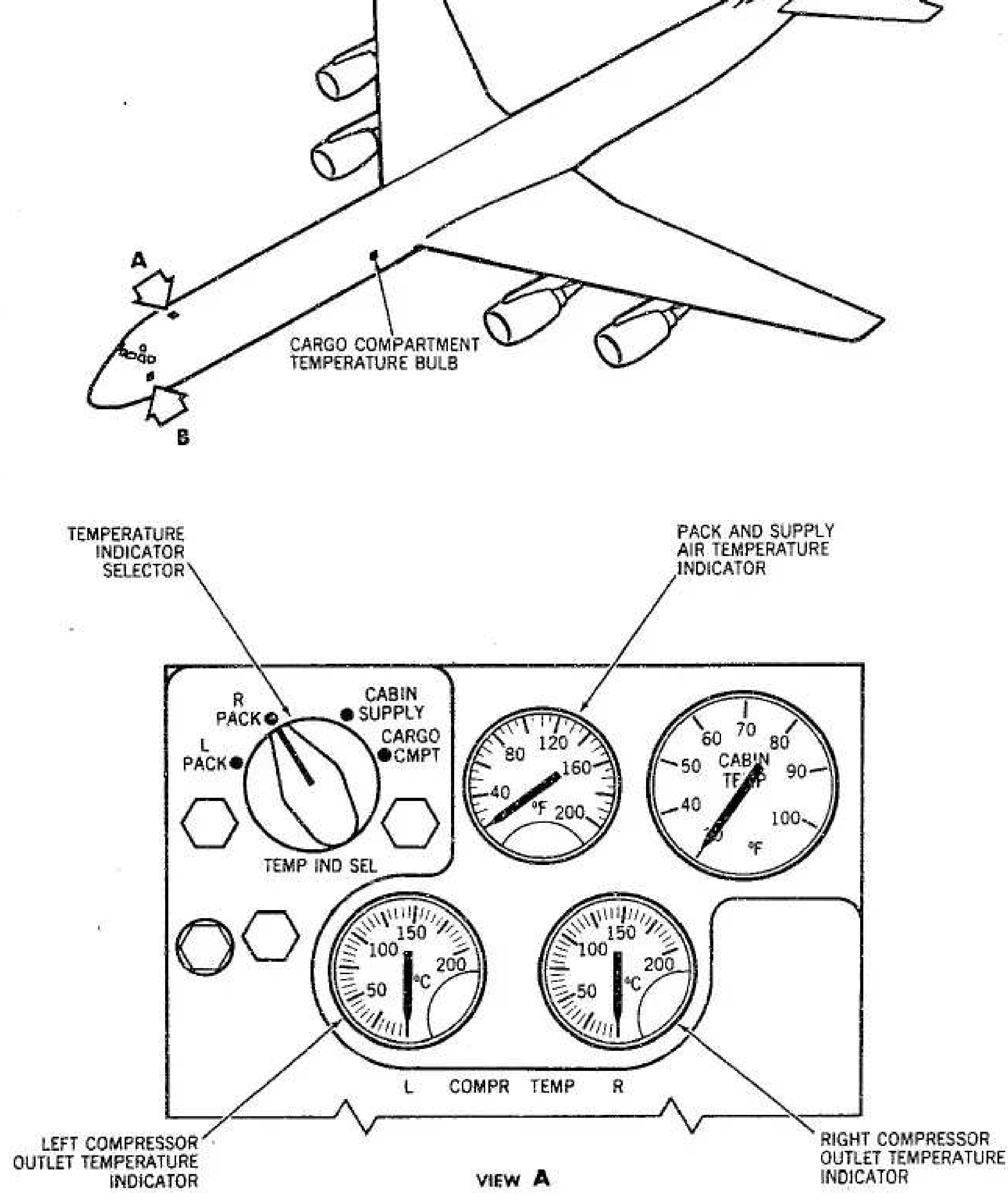

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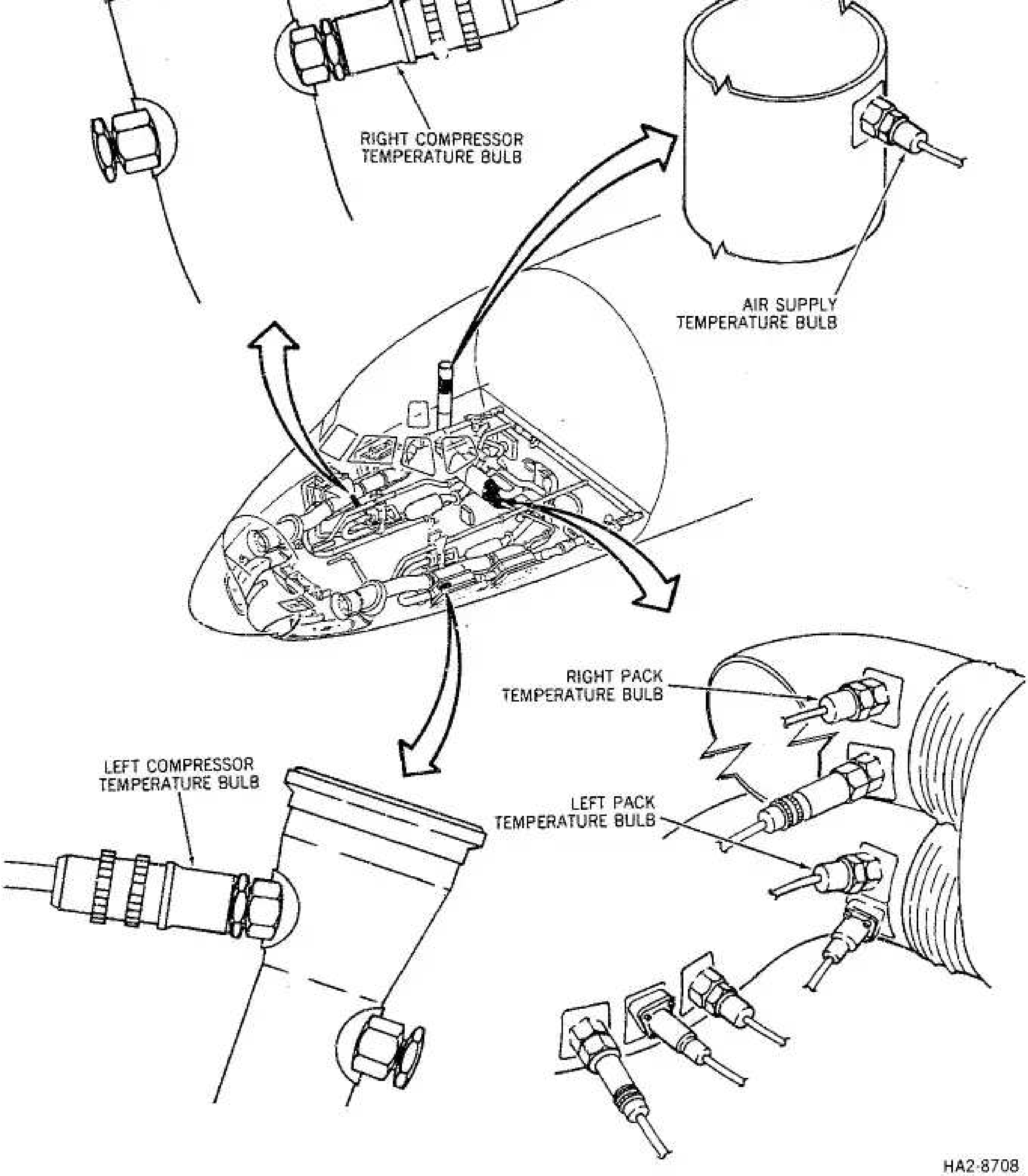
Temperature Indicating System Component Location
Figure 1 (Sheet 1)

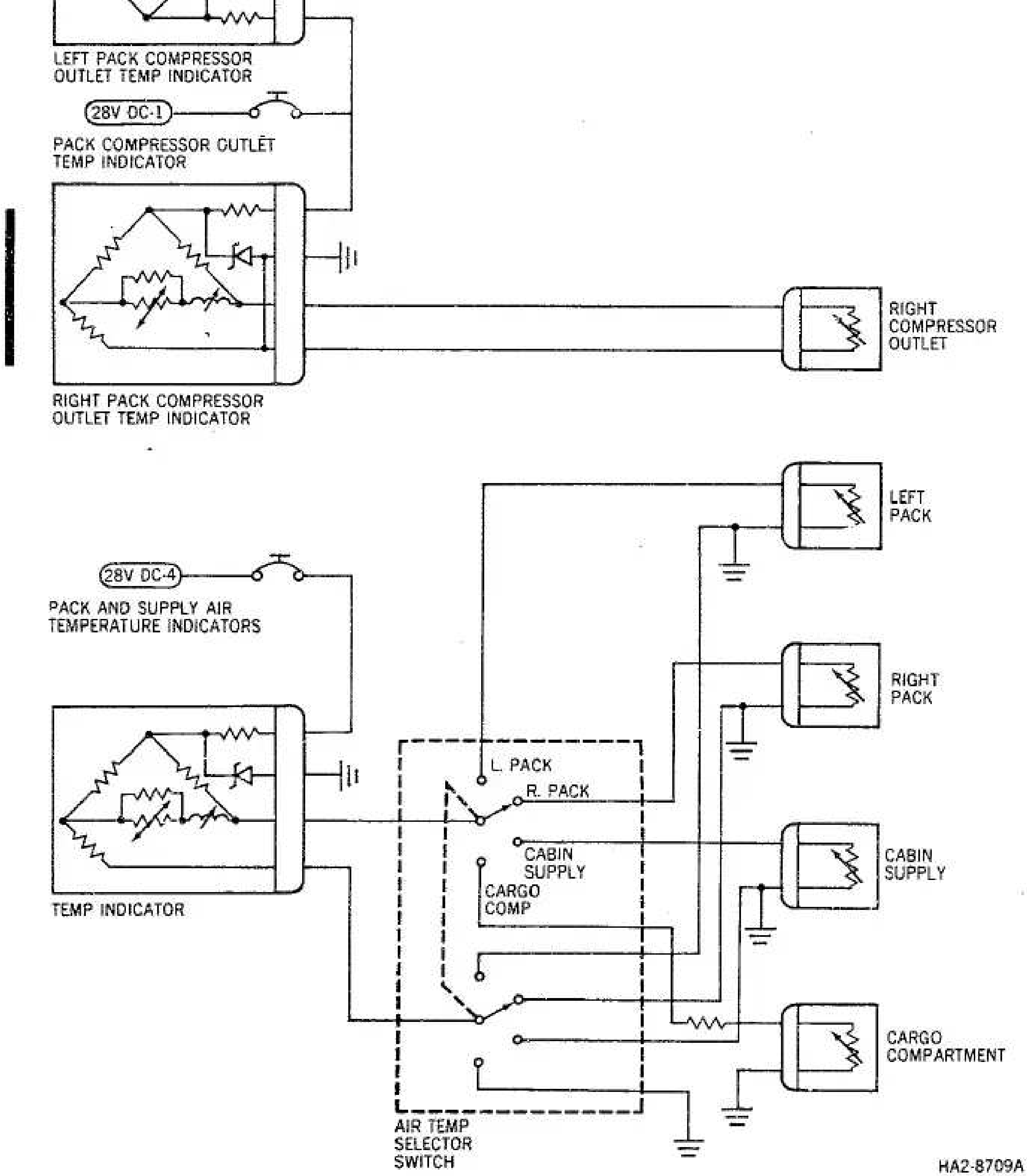


Temperature Indicating System Component Location
Figure 1 (Sheet 2)

2. Temperature Indicator Selector Switch

A. The temperature indicator selector switch is provided to permit switching from one temperature reading to another with only one temperature indicator. Each position completes a circuit through a temperature bulb whose resistance varies with changing temperature. There is no off position on the selector, therefore it is recommended that the selector be left in the

cabin supply position except when spot checking other temperature. In the cabin supply position, the indicator will reflect sudden temperature changes of either pack considerably faster than in any other position. (see Figure 2.)



Temperature Indicating System Schematic Circuit
Figure 2

TEMPERATURE INDICATING - DESCRIPTION AND OPERATION

1. General

A. The temperature indicating systems permit monitoring passenger compartment

temperature and provide information needed to regulate the ram air exhaust louver door system. The systems also provide the systems engineer an early warning of troubles in the cooling packs or air supply and assist in trouble shooting the air conditioning system. The systems are not intended as a means for checking accuracy of the various thermal switches and sensors used in air conditioning but may aid in checking proper function of control circuits.

B. Temperature indicating includes four separate temperature indicating systems. The systems are; two compressor discharge indicating systems, one for each cooling pack, an air temperature indicating system for cabin air supply temperature, left and right pack conditioned air temperature. Passenger compartment temperature indicating is discussed in section 21-60-0.

C. Each compressor discharge indicating system includes an indicator and a temperature bulb. The air temperature indicating system includes two temperature bulbs for pack temperatures, one bulb for air supply temperature, one temperature indicator, and a temperature indicator selector. (see Figure 1.)

D. Temperature bulbs are discussed in sections 21-55-0, cooling packs, and 21-60-0, temperature control. It should be noted however, that the slight lag in temperature indicating systems with respect to thermal switch overheat protection of cooling packs and temperature control and the location of temperature bulbs prevents the use of the temperature indicating systems for checking out accuracy of the other thermal sensing devices. The temperature bulb in the air supply duct is for sensing air temperature before it enters the compartment. Air temperature at this location is a result of the position of both mix valves. Since flight compartment and passenger compartment temperature requirements are likely to be different, supply temperature does not reflect either pack condition so long as both are operating. A malfunction in either pack however, which causes a sudden temperature change, will be noted on the indicator.

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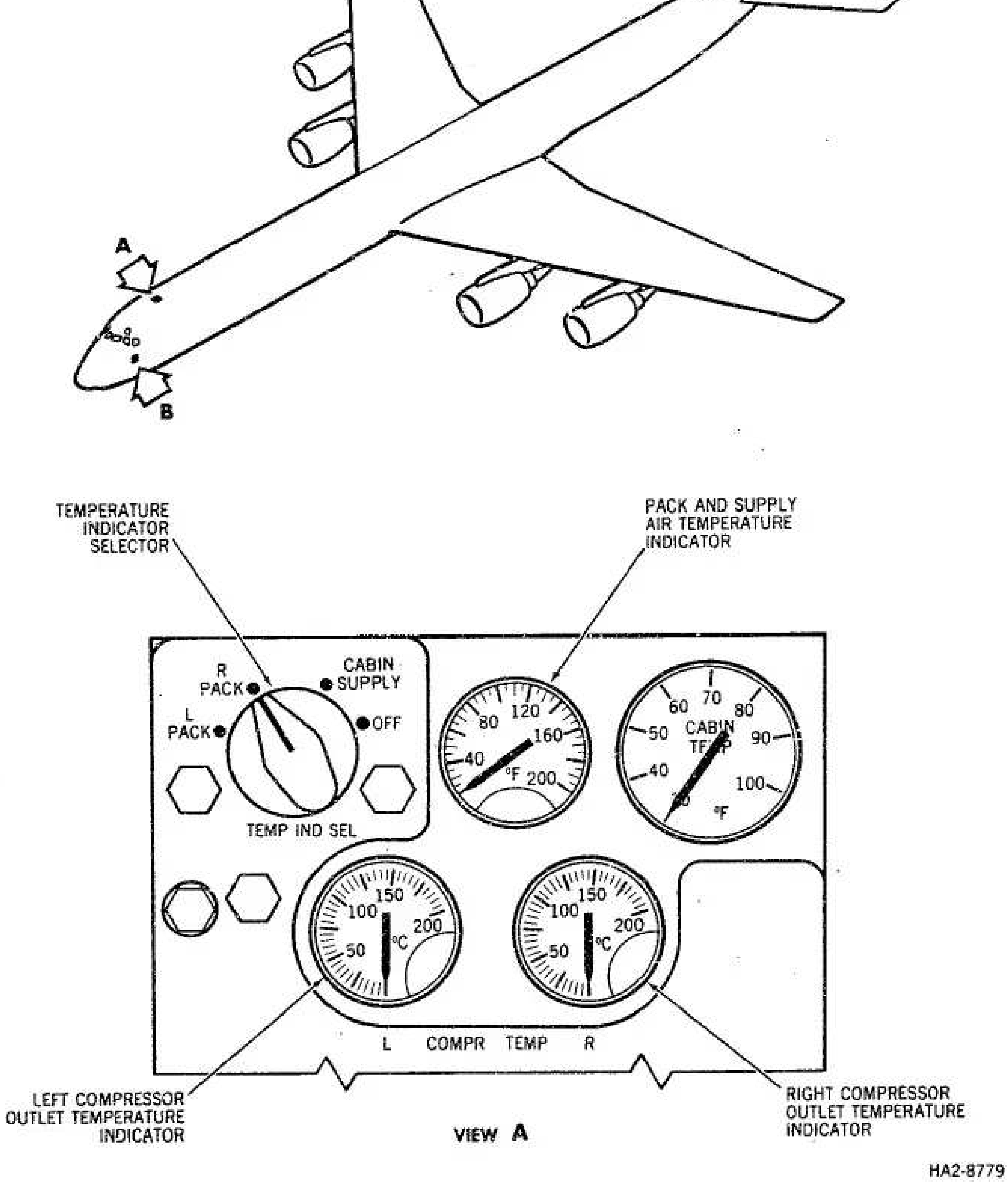
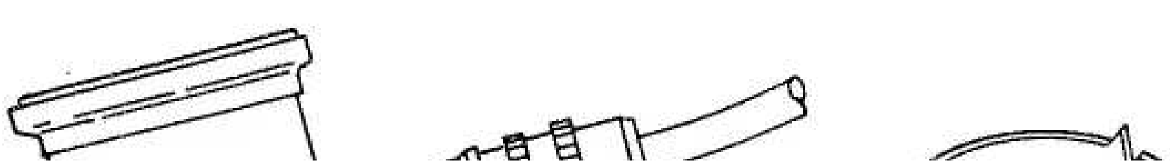
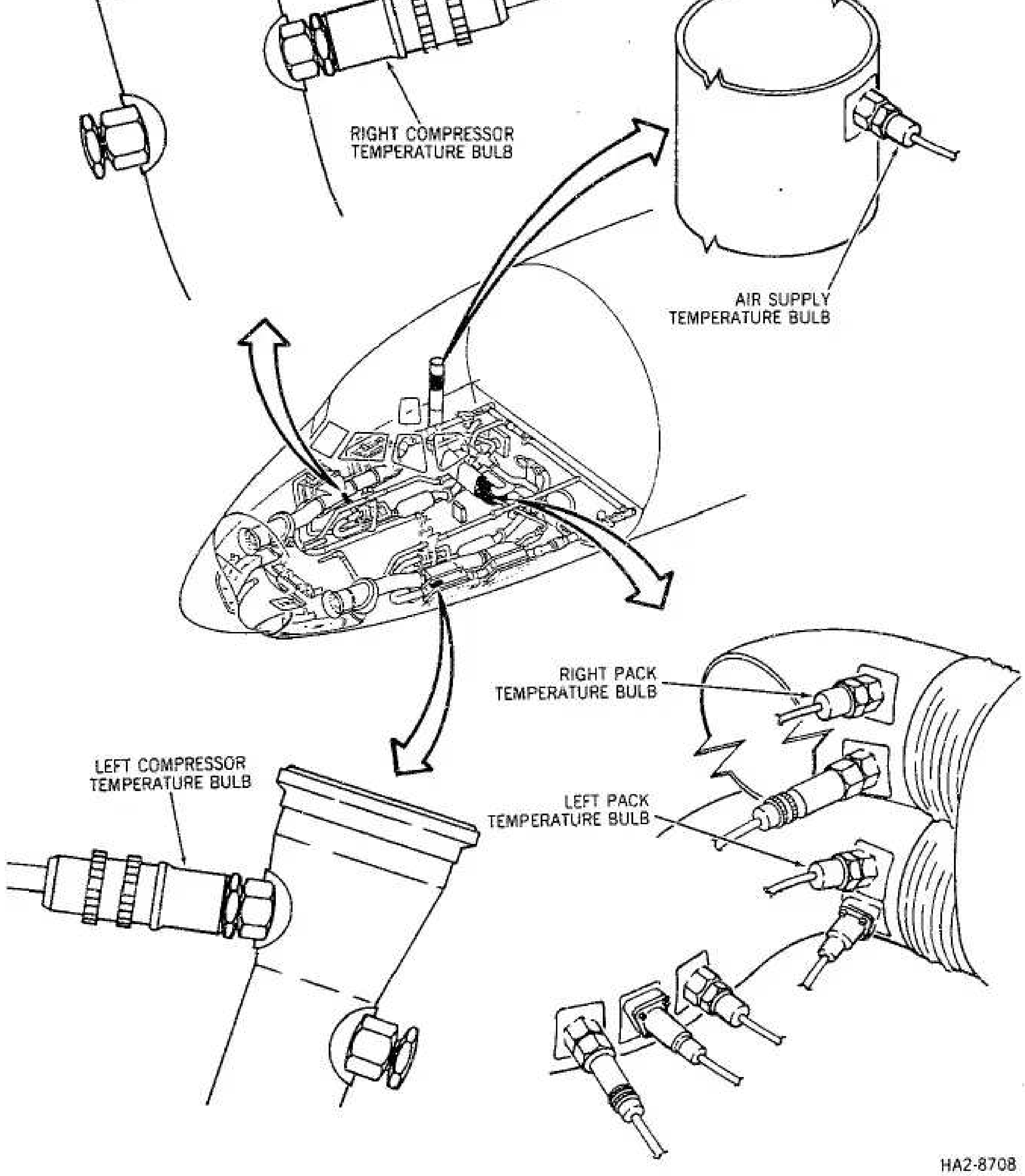


21-61-0 Temperature Indicating System Component Location
Figure 1 (Sheet 1)

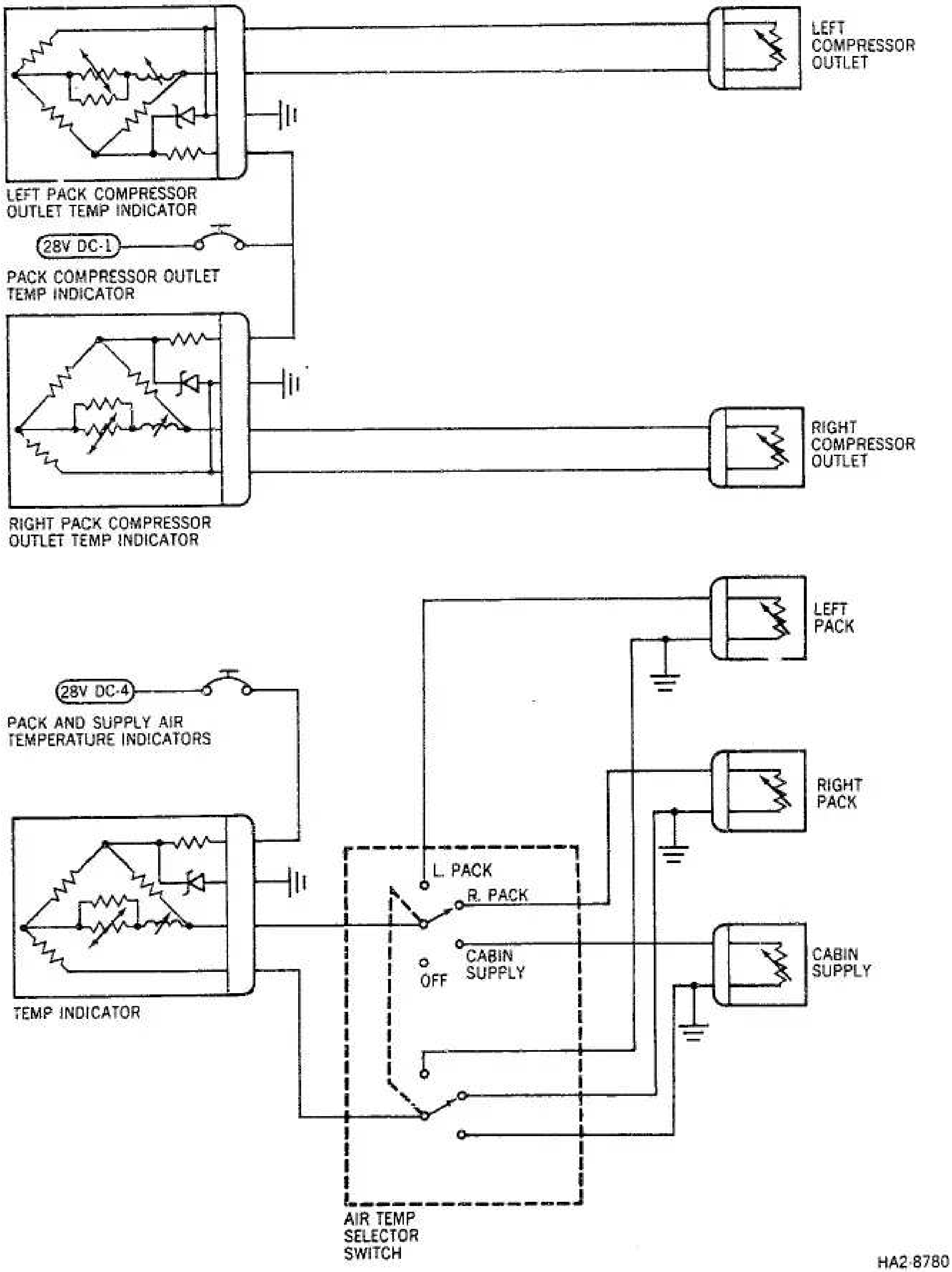




Temperature Indicating System Component Location
Figure 1 (Sheet 2)

2. Temperature Indicator Selector Switch

A. The temperature indicator selector switch is provided to permit switching from one temperature reading to another with only one temperature indicator. Each position completes a circuit through a temperature bulb whose resist-
R ance varies with changing temperature. The selector should be left in the
R cabin supply position except when spot checking for other temperatures. In the cabin supply position, the indicator will reflect sudden temperature changes of either pack considerably faster than in any other position. (see Figure 2.)



Temperature Indicating System Schematic Circuit
Figure 2

1. General

   A. The conditioned air duct temperature sensing elements for the left and right packs are installed in the distribution ducts downstream of the mixing valves in the air-conditioning accessory compartment.

   B. Access to the sensing elements is through the air-conditioning accessory compartment lower fuselage access doors.

   C. Removal and installation procedures for both sensing elements are identical.

2. Removal/Installation Conditioned Air Duct Temperature Sensing Element

   A. Remove Duct Temperature Bulb (See Figure 401)

      (1) Open pack and supply air temperature indicator circuit breaker located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker panel.

      (2) Remove electrical connector from duct temperature bulb.

      (3) Remove temperature bulb and O-ring.

   B. Install Duct Temperature Bulb

      (1) Make certain pack and supply air temperature indicator circuit breaker, located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker, is open.

      (2) Install O-ring on temperature bulb, install bulb into duct receptacle and tighten.

      (3) Install bulb electrical connector.

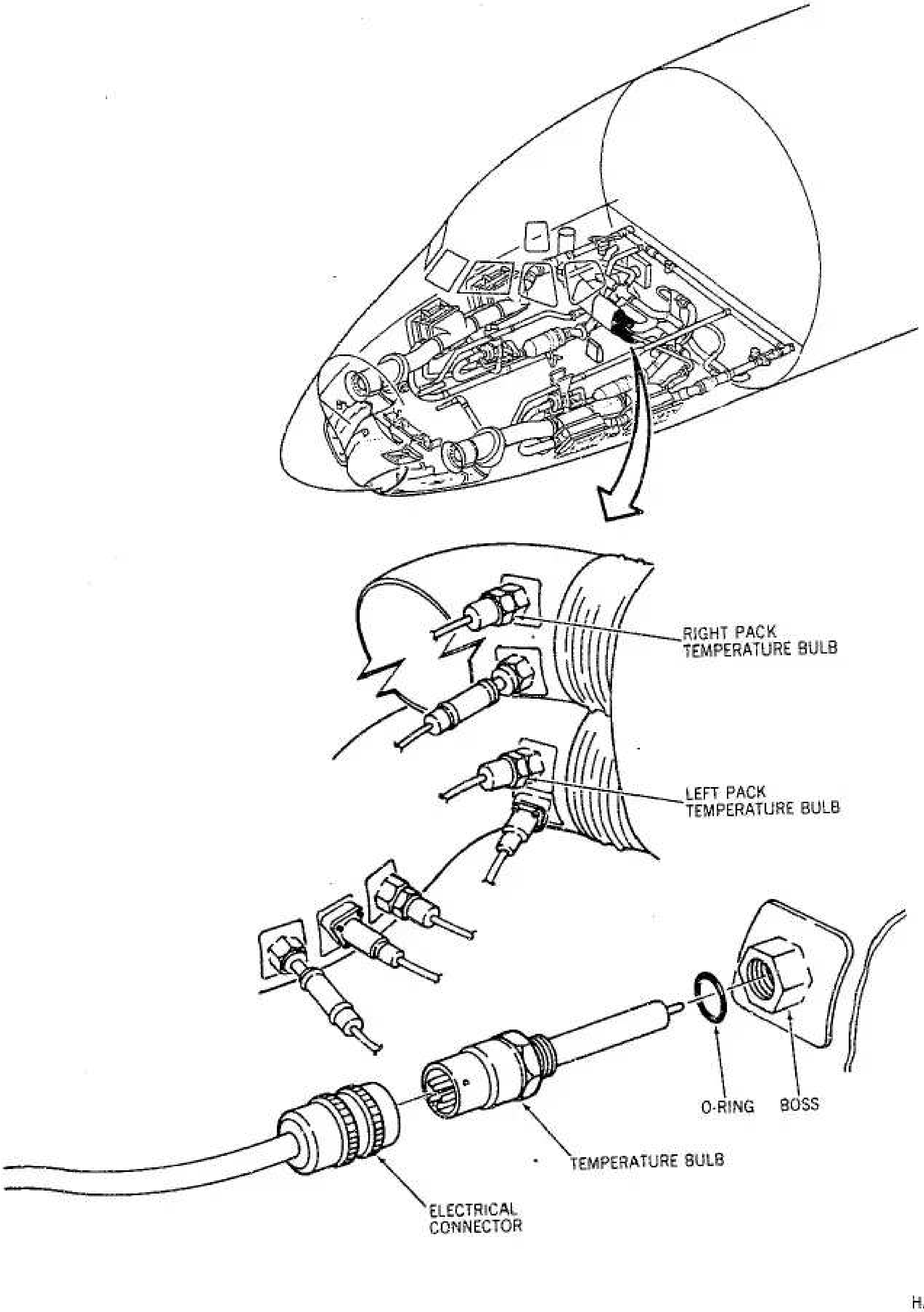
      (4) Connect external electrical power.

      (5) Close pack and supply air-temperature indicator circuit breaker.

      (6) Move temperature selector to left or right pack position and check that positive reading registers on the temperature indicator.

         NOTE: If air conditioning has not been in operation the reading will be approximately the temperature of the other pack.

      (7) Remove electrical power if no longer required.



Pack Temperature Bulb--Installation
Figure 401

1. General

   A. The conditioned air cabin supply duct temperature sensing element for the flight and cabin compartments is installed in the riser duct of the distribution system ducting, just aft of the electrical power center.

   B. Access to the sensing element is through the outboard lining of the flight compartment coatroom.

2. Removal/Installation Cabin Supply Temperature Bulb

   A. Remove Duct Temperature Bulb (Figure 401)

      (1) Open pack and supply air temperature indicator circuit breaker located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker panel.

      (2) Remove electrical connector from duct temperature bulb.

      (3) Unscrew temperature bulb from duct receptacle and remove temperature bulb and O-ring.

   B. Install Duct Temperature Bulb

      (1) Make certain pack and supply air temperature indicator circuit breaker, located on heat, vent, and ice protection (dc bus) section of EPC circuit breaker, is open.

      (2) Install O-ring on temperature bulb, screw bulb into duct receptacle and tighten.

      NOTE: If new bulb is being installed remove asbestos type gasket supplied with bulb and replace with O-ring type.

      (3) Install bulb electrical connector.

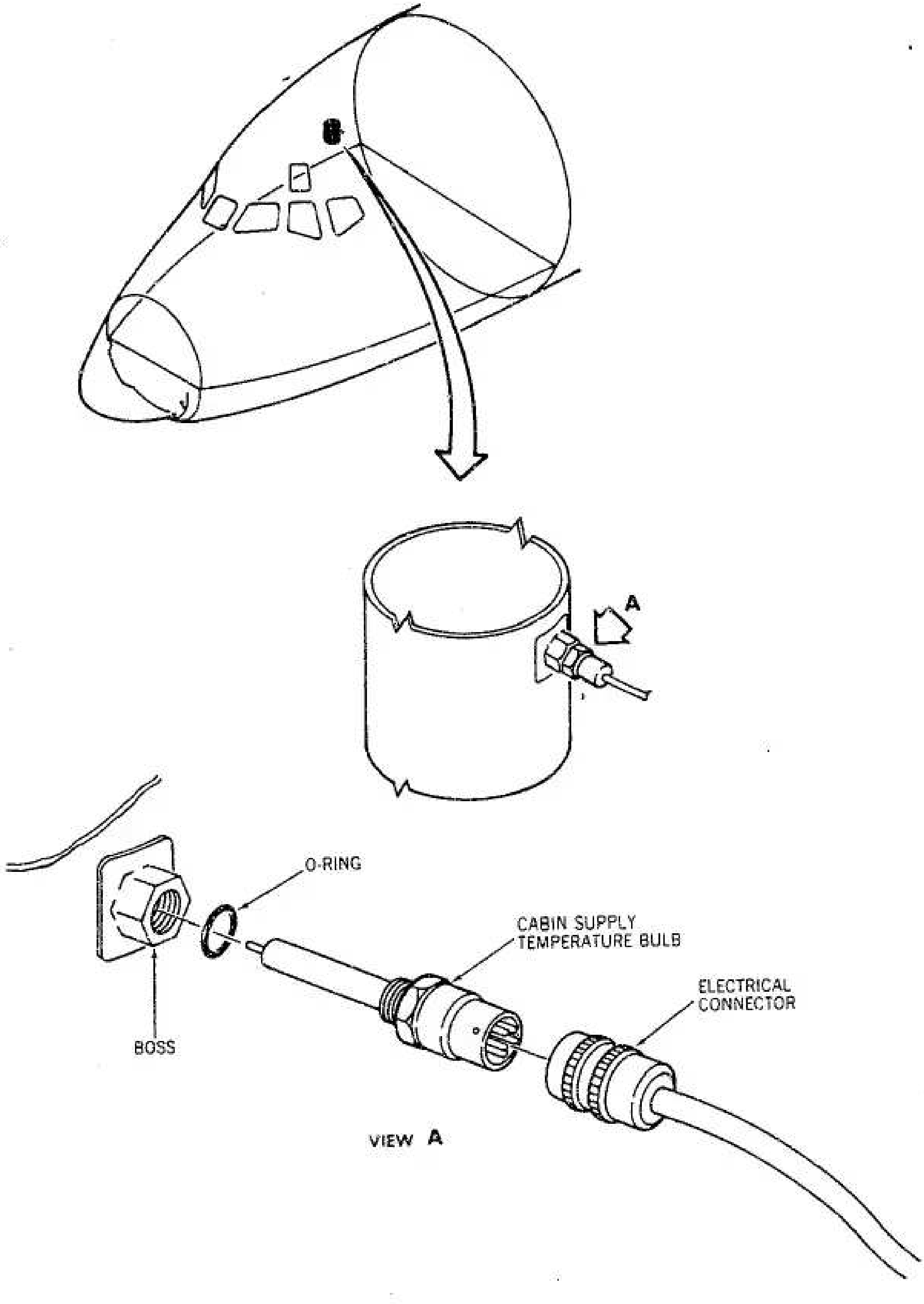
      (4) Connect external electrical power.

      (5) Close pack and supply air temperature indicator circuit breaker.

      (6) Move temperature indicator selector to cabin supply position and check that a positive reading registers on the temperature indicator.

      NOTE: If air conditioning has not been in operation the reading will be approximately the temperature of the left or right pack.

      (7) Remove electrical power if no longer required.



Cabin Air Supply Temperature Bulb--Installation
Figure 401